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Two Articles on Concrete Road Maintenance

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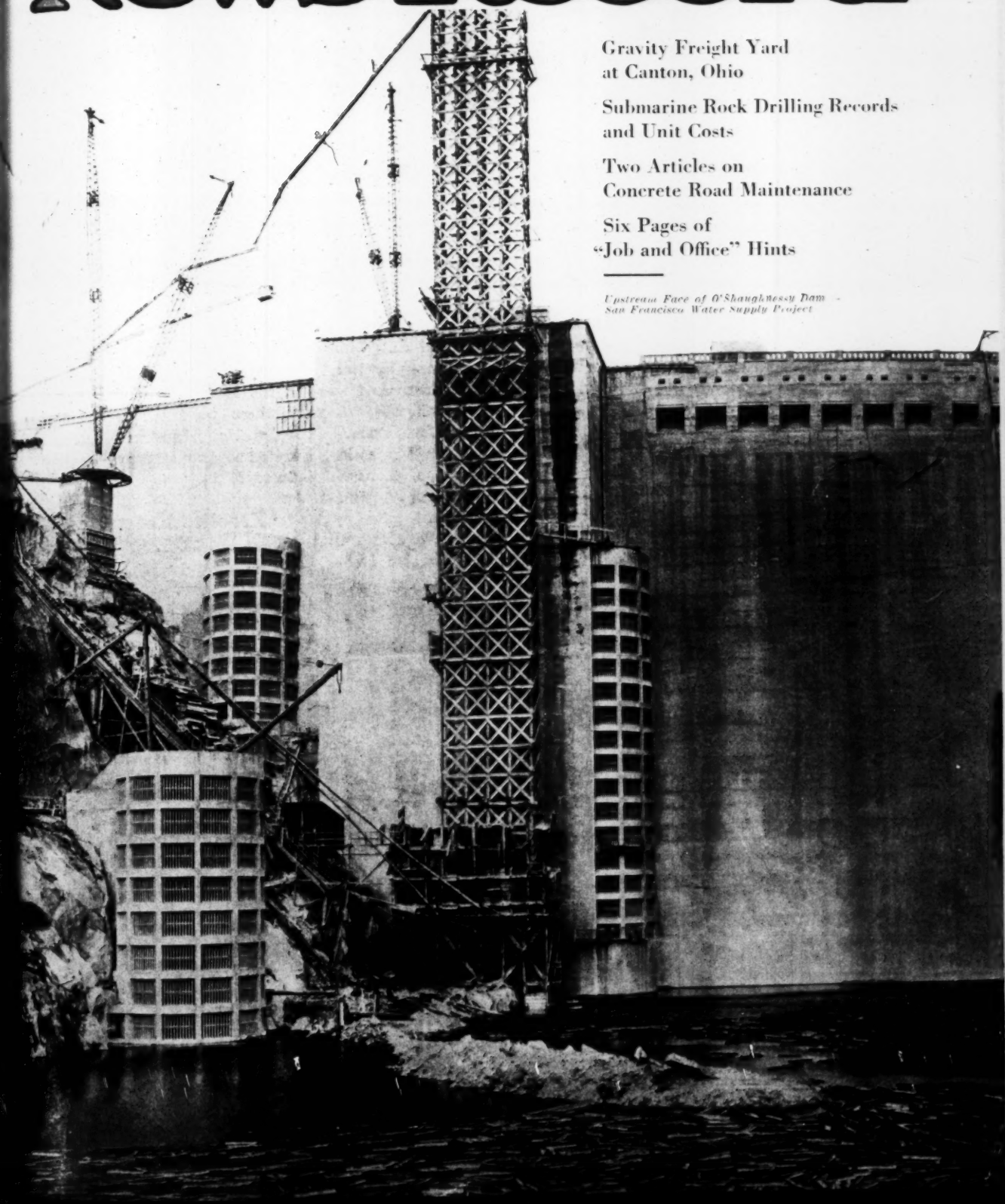

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ENGINEERING NEWS-RECORD

DEVOTED TO CIVIL ENGINEERING AND CONTRACTING

E. J. MEHREN, *Editor*
FRANK C. WIGHT, *Managing Editor*

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A New Start on Society Co-operation

BY ITS vote at the New Orleans meeting, the board of directors of the American Society of Civil Engineers indicated that it did not consider the recent referendum against the Federated American Engineering Societies as a mandate for isolation. The new committee to confer "with other national societies" looking toward engineering co-operation has no instructions other than those it may have absorbed by listening to the discussions of the board, so its future action in large measure depends upon its personnel and the degree of receptiveness with which its approaches to the other societies are met. The committee can hardly fail, however, to make every effort to initiate some scheme of co-operation which will satisfy the many civil engineers who think such co-operation imperative; nor can the directors of the other societies well refuse first to seek out the as yet unexpressed will of their members and then to discuss with the civil engineers the means whereby the mean of the combined wishes of all the engineers of the country can be approached.

Providing for Discussion

FROM a social point of view, last week's New Orleans meeting of the American Society was a distinct success. The good people of New Orleans were the best of hosts, the trees were green and the skies blue and the Mississippi obliged with a near flood which showed all the potentialities of high water with none of its dangers. No one who went but who would go again, given the leisure and the money. But as a technical meeting it fell a good way short of what these sectional meetings may some time become. Possibly the main function of these meetings is to introduce the members frequently to various parts of the country and, what is more important, introduce the scattered membership to the society as a working actuality. The New Orleans meeting did both these things most successfully. But after all the society is a technical body and the opportunity for technical discussion afforded by the presence of many distributed members should not be lost, as it was lost from lack of time or preparation at New Orleans. No one can spend a few days in the lower valley without realizing how controversial a subject has become the question of river control but no one would have learned it at the meetings. They consisted of calm presentation of some facts and a few arguments, none of which were given with any reference to those who held opposing views. It was hard to escape the conviction that the proceedings were altogether too dignified. A good open floor fight might have enlightened all the hearers, brought forth useful information and revealed states of mind. The written discussions may do all of these things for a much larger audience but if it is not worth while or feasible fully to enlighten the attendant at a meeting, is it worth while only partly to enlighten him? Either the technical side of the sectional meetings should be left out altogether or some preparation and allocation of time should be made for free discussion. When the technical divisions get to functioning there will doubtless come the kind of planning and the concentration of interest which is necessary for a successful floor discussion, and then the quarterly meetings will become what they already promise—the most forward step in the society's recent history.

The Right Method of Attack

ALARMED by the increasing number of automobile accidents at grade crossings, thoughtful people are casting about for some means of preventing such accidents. Snap judgment would dictate entire elimination of the grade crossings as an answer to the question, but entire elimination would bankrupt the railroads and throw too great a burden on the taxpayer. The alternative then is to improve the crossings and provide them with adequate protection. The problem of providing such protection must be tackled by both the railway and the highway authorities and must be tackled quickly. To do it quickly and with the least expense will require co-operation, not conflict, among the parties concerned. New Jersey has grasped this idea. This issue reports a conference of railroad officials, state and county highway authorities and the state regulatory board, at which conference the problem was outlined, an ultimate goal set, and a definite step taken toward reaching that goal.

Sound Sense as to Publicity

LIKE a breath of fresh air in a close room comes the report of the publicity committee of the Iowa Engineering Society, abstracted elsewhere in this issue. We offer our compliments to the framers of this report. It is a gratifying reminder that all engineers have not been stampeded from their traditional good judgment and their respect for sound reason and the realities. The reliance of so many engineers upon publicity as a "magic automatic elevator"—to quote the committee—and their readiness to accept the press agent as the "elevator man" has been pathetic. And even more pathetic and inexplicable has been the readiness of some who should know better to invoke in behalf of their profession the ethics and the practices we have come to expect in connection with the promotion activities of the stage, the screen and the legislative lobby. So great a capacity for self-deception and self-justification is not what we have been taught to expect from the engineer. Mr. Schlick's committee does well also to point out that, while the societies may guide or supplement individual effort, they cannot take its place in building up public respect for the profession. When the public has a satisfactory experience with one engineer as a fellow citizen it is inclined to think well of engineers in general; when it sees one engineer achieve leadership in his community it is inclined to look upon the engineer in the abstract as having the stuff of

which leaders are made. The committee is on sound ground also when it expresses its belief that some of the qualities of leadership, now potential in engineers as a class, must be developed and strengthened before they will be ready to play their full part in public affairs. That development can come mainly through development of the individual, and that in turn can come best through his individual participation in public affairs as a citizen possessing peculiar abilities to be of service to his fellows.

Private Bridge Enterprise

WITH THE conclusion of arrangements for financing and starting actual construction on the Anthony's Nose-Bear Mountain bridge over the Hudson River, as announced during the past week, private enterprise again enters the field in which it played an important part generations ago. Toll-bridge construction is likely to become a prominent factor in the highway field during the next decade or more. The needs of the day call for it, and with wise regulation it should be in all respects sound and favorable to the development of the community. More than once during the past two or three years *Engineering News-Record* has advocated construction of main bridges over large water barriers by private enterprise as the only available method of providing much needed links of communication across barriers that now isolate large and flourishing regions from each other. The case of these major crossings differs fundamentally from that of the ordinary highway bridge across a small stream. Small bridges are built wherever any highway encounters a stream, while at major streams the one or two most desirable crossings out of a hundred possible ones must be selected, as it is financially impracticable to build all. Distributing the cost of minor bridges over the entire tax roll is equitable and avoids the impossible burden upon traffic of toll collections at bridges; but the cost of large crossings is apt to burden the tax roll with an inordinately large item which is of advantage to a limited number of users, while on the other hand toll collection at such points is not burdensome to traffic. Private enterprise, in other words, tends to assure the construction of that crossing which is most desired by the traffic and places the cost upon the traffic that demands its construction. It has still another advantage: Since the mounting burden of public expenditures renders quite impossible for the present any general policy of constructing large highway bridges by public moneys, we must either do without these badly needed crossings or build them with private money on the toll basis. For these reasons we believe that the efficient development of our highway traffic system will be furthered by extension of the tendency indicated by the Anthony's Nose project.

Two O'Shaughnessy Dams

THE six million dollar concrete dam, 341 ft. high, which has just been completed on the Hetch Hetchy project, has been named O'Shaughnessy Dam in honor of M. M. O'Shaughnessy, city engineer of San Francisco, who has been more closely identified with the project as a whole and with this structure in particular than has any other individual. The Board of Supervisors of San Francisco officially named the structure on the suggestion of the local chapter of the American Association of Engineers, despite Mr. O'Shaughnessy's comment that it is not good policy to erect monuments to a man who is still living because before he dies he may do something to change public sentiment. It is appropriate that Mr. O'Shaughnessy should be honored for the great part he has played in consummating the Hetch Hetchy project. The obstacles and opposition that had to be overcome presented more difficulties and worries than all the construction work thus far accomplished by Mr. O'Shaughnessy, who has borne the brunt of all Hetch Hetchy battles for ten years past. Deserving of honor for this work as is M. M. O'Shaughnessy, it is a pity that the engineers and city authorities of San Francisco responsible for the action mentioned above, were unaware, as it is only fair to assume they were, of the fact that two years ago the city authorities of Columbus, Ohio, honored the memory of Jerry O'Shaughnessy by designating as the O'Shaughnessy Dam the new water-works dam for that city—as a correspondent states elsewhere in this issue. Thus, unless San Francisco finds some other way of honoring M. M. O'Shaughnessy, confusion will result from the use of identical names for two water-works dams. Moreover, the notable structure which M. M. O'Shaughnessy has so ably promoted and built has been recorded for a dozen years or so, both in engineering and more general literature, as the Hetch Hetchy Dam, a fact that will make for much confusion in connection with so notable an engineering structure.

The D. & H. Celebration

CENTENNIAL celebrations of privately conducted enterprises are decidedly rare in this country. The celebration of its centenary, therefore, by the Delaware & Hudson Co. this week is an event that prompts reflection not only upon transportation progress and its influence on national development, but on the maturing character on our industrial organization. To the first of these topics, transportation, the speakers at the gala dinner in New York naturally gave chief attention. The main theme that ran through the addresses deserves repetition—indeed, cannot be too often repeated: that efficient transportation, pushed aggressively ahead of industrial and agricultural development, is just as necessary for the maintenance of our prosperity and our national welfare today as it was for the welding together of our nation and the encouragement of its growth in the last century. The health of our railroads, in particular, must be a matter of national concern, of national education. The man in the street must be made to understand it; otherwise we may expect only the destructive action at Washington and in state legislatures. The obligation of engineers, contractors, manufacturers to think soundly on railway legislation and regulation, to furnish what leadership they can, is apparent. * * * The maturing character—or at least maturing age—of our industrial development is apt to be forgotten. True, our industry, by and large, is still youthful. But there are some lusty old fellows among us, when individual organizations begin to celebrate their centenaries. It indicates that we have, even though it be unconscious, some business traditions. The meteoric character of the new often blots out the substantiality of the old. Young industries rise and often fall, and their fall is due to the neglect of the lessons which our maturer industries could have taught them. We need to acquire a higher regard for the principles which these industries have worked out. Greater business stability would result.

Concrete Road Maintenance

METHODS and costs of concrete road maintenance are presented somewhat completely in two articles in this issue. Although practice in only one state is explained this state was the pioneer in building in large mileages the type of paved road that is now ascendant in most states. For over a decade pilgrimages have been made to the concrete roads of Wayne County. It is not as an isolated example, therefore, that one must consider Michigan practice, but as an embodiment of the latest experience and the best technique in keeping up concrete paved highways. This understanding is necessary to full appreciation of the articles being considered.

Demanding first notice are the figures of cost—particularly those given for Wayne County. It is rare that well segregated costs of upkeep and a careful census of traffic are co-ordinated as they are in these records to furnish values in terms of service. The roads considered have representative variety—some of them are modern and some old and of a structure now regarded inferior; some of them carry a moderate traffic and some an exceedingly heavy traffic. About as low and also about as high maintenance costs as concrete pavements in ordinary highway service may ever be expected to show are represented by the figures given. In view of these facts the assertion in the article that concrete road upkeep does not exceed the rates—2 to 4 per cent—of upkeep on well maintained buildings, is worth keeping in mind.

While the demonstration is clear that the cost of maintaining concrete roads is not extravagant in comparison with the cost of keeping up working structures of other sorts it is quite as clear that the concrete road is annually a mounting expense. It is plain too that unless we consider service, annual costs have no great constructive significance. The traffic census is a necessary accessory of maintenance cost determinations. Also to contribute most it must give more than vehicle mileages; it must give ton mileages. These are not new ideas but they are given emphasis anew by the maintenance cost records of 1922 in Wayne County.

With the aggregation of large mileages of concrete roads in limited areas, as in Wayne County (Detroit), Milwaukee County (Milwaukee), Cook County (Chicago) and other centers of population, there is portended a change in maintenance methods. The small gang with its individual little outfit for filling cracks and making patches will be replaced by central mixing plants both for concrete and bituminous materials supplying larger gangs outfitted with tank trucks or, in case of concrete patching, with trucks equipped for wet batch haulage. Both articles published in this issue give interesting examples of this departure in practice.

A question which naturally arises is: How is the central mixing plant to be co-ordinated with maintenance by patrol? Extension of special gang maintenance to these at present occasional conditions of mileage concentration is one possibility. Another is to have a common central supply plant for a group of contiguous patrol sections. There are too many factors to be considered to attempt any decision here, but a decision will be called for as situations develop where groups of roads offer opportunities for economy by central plant service.

In the family of highway activities maintenance has been the little sister in the cut-down skirts. After appropriations for construction, maintenance has been fitted out with what remained. This condition prevails in practically every state which has not a generation of improved roads. It is now beginning to be remedied and it follows that some of the best thinking of highway engineers is being done in maintenance.

How Can We Stop Duplication of Orders?

THE BUILDING industry is suffering from duplication of orders. To insure the receipt of materials, contractors and dealers, fearing a shortage, are ordering double and treble the quantities they will actually require. The result may be, before long, serious "apparent" shortage of materials, with consequent additional price increases. Thus there will be further discouragement to building to the detriment of the public and of the construction industry.

But it is not only the consumer of building materials that suffers. The manufacturer also is a victim. If he takes the full face of orders as *bona fide*, he is now believing that he is well sold up for the season. Nevertheless, when the expected time of heavy shipments arrives he will probably receive heavy cancellations with the result that his piled up stocks, carried usually with the assistance of bank loans, will be left on his hands.

Both consumer and producer, therefore, suffer from present practice. What is the remedy?

The seat of the trouble lies in the form of order for the purchase of many building materials and in the accompanying trade practice. This form of order is called a "contract," though in its use it is a travesty on that respected form of legal document. A contract implies mutual advantage or concession. In the alleged "contract" for buying building materials the manufacturer guarantees not to raise the price. That should be sufficient concession from him; that is the advantage which he surrenders to the purchaser. But on top of that he guarantees to give the purchaser the lower price in case the market declines and then—concession of concessions—in actual practice permits the purchaser to cancel without any penalty whatever.

In return for these concessions, what does the purchaser agree to do? Absolutely nothing. He is protected in price against both rise and decline. Under trade practice he may cancel if he wishes. The advantages are his; the risks are the producer's. There is no mutuality. The "contract" in fact, is not a contract; it is an option, giving all advantage to the buyer and imposing, as the trade construes it, no obligation.

Mutuality would certainly demand that the intending purchaser, in return for price protection, should guarantee to take the material in accordance with the terms of the order or incur a financial penalty for cancellation.

In other words, a non-cancellable form of contract, or one carrying financial penalty for cancellation, would be a contract in the true sense—in that it would impose reciprocal obligations. It would hold forth definite advantage to the buyer; it would insure the producer against cancellation.

At this very time, everyone in the construction industry is fearful that rising costs will start a serious retarding movement in construction. It is an opportune time for the industry as a whole to eliminate features that encourage inflation. A good start would be made by adopting a fair materials purchase contract—a contract that would be in reality a contract, in which both parties would have obligations and advantages.

Concrete Road Maintenance Methods and Tools

Crack Filling Processes—Materials for Filling Joints—Patching Tools and Procedure—Central Mixing Plants—Resurfacing and Widening Methods—Costs

By G. C. Dillman
Deputy Commissioner, Michigan State Highway Department, Lansing, Mich.

State road maintenance through county organizations is the practice in Michigan. Some of the counties, a notable example being Wayne County in which is the city of Detroit, have large mileages of concrete road and liberal appropriations for their maintenance and practices have been highly perfected. The author of this article as deputy commissioner in charge of state maintenance has direct knowledge of these practices and has summarized their outstanding features. His consideration includes not only the normal tasks of filling cracks and joints and patching breaks, but also resurfacing, widening and marking. It is perhaps the best presentation recently published of strictly modern methods and equipment for concrete road maintenance.—Editor.

CRACKS in a concrete pavement do not necessarily indicate failure. However, all joints and cracks should be filled. Should they be neglected for a considerable length of time there will follow spalling of the concrete next to the opening. Continued neglect will result in water entering through the crack to the subgrade and a depression across the pavement follows. Concrete pavements, therefore, must be patrolled. The repair men should go over concrete roads at least every three to six months when the traffic is comparatively light and every month if the pavement has been built for some years and is carrying a traffic of 5,000 or more vehicles per day.

Repairing Cracks—In making repairs, cracks and construction joints should first be swept out with wire or stiff fiber brooms. If the pavement is old, there may be loose tar or asphalt filler that is of no further value. This should all be hooked out and the crack then swept before refilling. Instead of an ordinary pouring can a conical shaped can is recommended; it has these advantages: (1) Absolute control over material; (2) Wind cannot disturb; (3) Amount of material used is reduced and (4) The workmanship is better.

The conical shaped pouring can should have a capacity of about 2½ gal., and be provided with a wire shut-off, the wire extending up through the closed top. A wooden handle should be attached to the top and to the bottom should be securely fastened a cast-iron tip or shoe. The can must have an opening in the side near the top through which it may be filled. In operation it is filled with the heated tar or asphalt and then moved along the crack or joint at such a rate that, with the flow of material regulated by means of the shut-off, the crevice is completely filled and no more. Dry sand, preferably sharp and coarse, is then cast on the hot material so traffic will not pick it up. Should the concrete next to a crack or joint be chipped to the extent that there is an appreciable depression, the filler should be allowed to spread out to fill the low place and then be covered with granite chips ranging from ¼ to ½ in.

Slight depressions caused by the action of traffic or defective spots in the pavement containing lumps of clay, unsound or soft aggregate or perhaps sticks, are repaired by a thorough cleaning, the application of bituminous material and a covering of granite chips or their equivalent, care being taken to use no more material than is required to bring the patch flush with the surrounding surface. When defective places of any considerable size or depth less than the thickness of the pavement slab are to be repaired, the edges should be cut down until they are vertical. After thoroughly cleaning the hole it should be painted with tar or asphalt after which it is filled with clean hard stone of suitable size—the stone keyed in by tamping if the hole is of some depth—and grouted with tar or asphalt virtually making a penetration patch. The surface of the patch should be covered with clean pea gravel or stone chips. The bituminous material used for this purpose should be the same as that used in the construction of bituminous or penetration macadam. A cold mix of small stone and suitable bituminous material may also be used successfully.

Joint Fillers—The joint filler should be a bituminous material that does not get too soft during the summer or too hard and brittle during the winter. Most tar fillers now in the market and intended for year-around use have this fault and after watching results in many sections of Michigan, it has been decided to do away with the purchase of any joint fillers by trade name. Road officials should specify the material to be used and through proper laboratory control see that it is secured.

Tar joint fillers used in Michigan have a softening point (cube in water method) ranging from 90 to 100 deg. F. for the softer fillers and 105 to 110 deg. F. for the heavier ones. A filler meeting the lower limit for softening point will not last for any length of time because it will work down through a crack or joint and if not may pick up in warm weather. A filler meeting the higher limit will become too brittle during the winter months and may chip to the extent that the crack will not remain water proof as long as it should.

To meet the needs for a tar filler that is satisfactory the following specification is recommended for use throughout the year for such a climate as is had in Michigan:

The refined tar shall be homogeneous and free from water and shall meet the following requirements:
1. Specific gravity 25 deg. C.—25 deg. C. 1.20 to 1.28.
2. Softening point 35 deg. C. to 41 deg. C. (95 deg. F. to 105 deg. F.)
3. Total distillate by weight.
   To 170 deg. C. not over 1.0 per cent.
   To 270 deg. C. not over 12.0 per cent.
   To 300 deg. C. not over 20.0 per cent.
4. Softening point of residue from (3) not over 75 deg. C.
5. Total bitumen 80 per cent to 95 per cent.

Asphaltic joint filler has not had very general use although it is quite generally recognized that blown asphalt is desirable for this purpose. The blowing

process imparts certain desirable characteristics that cannot be secured in any other way, chief among them being the change to a more or less rubbery product. The blowing process is in quite general use by manufacturers of asphalt products and it should work no hardship if blown asphalt is specified. On account of the characteristics of this material, it will not become unduly soft during the summer months and does not become brittle except possibly for a slight depth at the surface during the winter.

An asphaltic joint filler such as referred to is on par with a tar filler. It should meet the following specifications which are the Bureau of Public Roads' specifications P. A. F.-1 with exception that blown asphalt is specified:

The oil asphalt shall be *partially blown*, homogeneous, free from water, and shall meet the following requirements:
1. Specific gravity 25 deg. C—25 deg. C. not less than 0.980.
2. Flash point not less than 200 deg. C.
3. Softening point not less than 80 deg. C.
4. Ductility at 25 deg. C. not less than 2.
5. Penetration at 25 deg. C. 100 g., 5 sec., 30 to 50.
   Penetration at 0 deg. C. 200 g., 1 min., not less than 20.
6. Loss at 163 deg. C. 5 hours not more than 1.0 per cent.
   Penetration of residue at 25 deg. C. 100 g., 5 sec., not less than 20.
7. Total bitumen (soluble in carbon disulphide) not less than 99.5 per cent.
   (a) Organic matter insoluble not more than 0.2 per cent.

Uneven Joints—Uneven joints are caused by faulty construction. Either the expansion joint was not vertical, allowing one concrete slab to push above the adjoining slab when the concrete expanded or the surface was not properly finished at the joint and should be cut down. In case one slab has heaved above the other and will not settle back into its proper place in a short time, the concrete on the high side should be cut out from 8 to 12 in. back from the joint and for the full width of the pavement. The face of each slab should then be made vertical and the opening refilled with concrete.

Breaking up Concrete—Until quite recently the removal of broken sections of concrete when making repairs or cutting through a concrete pavement in order to do certain underground work was considered difficult and unduly expensive and was undertaken only as a last resort. With recent development in the use of compressed air operated machines for making pavement cuts, this type of work has become simplified; time and labor saved with a resulting saving in money, and much better control over the work secured than by hand methods.

The "paving breaker" is a one-man outfit. It is nonrotating in action and operates on the same principle as the hammer drill. Shanked steels with moil or chisel bits are used to break up the concrete. The concrete to be taken out is first outlined with chalk, then the moil point is driven into the concrete several times at an angle until a hole is made. It is then enlarged to conform to the chalk outline and the edges of the opening are made vertical by means of the chisel bit. If a portion of the subgrade is to be removed and is of clay or shale, it can be very easily loosened by driving the moil into it a few times in a lifting position.

Two paving breakers may be operated by compressed air furnished by a portable gasoline driven compressor. For general use the complete outfit should be mounted on a truck or trailer so it can be quickly transported from place to place.

Hammers have also been built on the rear of motor trucks. The hammers should weight from 800 to 1,000 lb. and in the center of the hitting face should be fixed a tool-steel point. This device is very effective and efficient for cutting out a strip of concrete along the edge of an existing pavement but is not as practical as a paving breaker which gives absolute control of the location of the break in the slab.

Repairing Holes—After removing the broken concrete the sides of the pavement still in place should be squared up leaving vertical edges as regular as possible. Then dig out the soft subgrade to solid ground or perhaps to an old road bed. This will generally be of sufficient depth for the old broken concrete to be placed in the bottom and provide for about 8 in. of new pavement above the old concrete. Any accumulation of water should first be removed. Only one layer of the broken concrete should be placed in the bottom and the pieces not too close together because the concrete to be placed should surround the broken pieces, otherwise a more or less porous base may be obtained when the new concrete is poured. The slab intact should be undermined about 4 in. to provide a supporting shelf or footing.

It is well when practicable to cut bleeders through the shoulders of the road and fill with stone, coarse gravel or small pieces of broken concrete in order to give proper drainage to the subgrade under the patch. This is especially important when the subgrade is a very retentive soil.

The mix used in making these patches should be 1 part cement, ½ sand and 3 gravel or crushed stone. The concrete should be dense and well spaded. Care must be taken to strike off and finish the surface of the patch so that it will conform with the general contour of the pavement surface surrounding it. The new concrete should be covered with earth and kept well damped for a few days after being placed. Unless an accelerator is added to the mix, the patch should be closed to traffic for two weeks and after it is thoroughly cured and under traffic for some time, the edges should be treated with bituminous filler to prevent chipping.

Central Mixing Plants—When there is a considerable mileage of concrete surface requiring extensive patching, a central mixing plant should be installed for the following reasons: (1) The mixing operations are removed from the road grade, thus reducing confusion to traffic; (2) stock piles of materials and loaded trucks are not taking up part of the roadway; and (3) the method is more economical.

When considering the location of a central mixing plant, the cost of delivering raw materials to the plant must be balanced against the cost of delivering the concrete to the road to be repaired. During the past summer approximately 5,000 sq.yd. of concrete pavement was repaired on the Dixie Highway in Monroe County, Michigan. The way this work was carried out, because of the volume of work done and because it was one of the first successful central mixing plant operations in repairing concrete surfaces on country roads, deserves description.

The mixing plant consisted of a two-bag mixer placed on the ground level. Adjacent to the mixer was erected a portable steel building for storing cement. The building had a capacity of two cars. The operation of the mixer required one mixer man, one cement man and two to four wheelbarrow men depending on the haul. The concrete was transported from the mixer in Ford trucks with high speed gears and the trucks carried slightly less than ¾ cu.yd. of mixed material and traveled on

the extreme hauls at about 30 miles per hour. The minimum amount of patching was done at the north end of the road, which was the extreme haul of about ten miles, and the material was delivered from the mixer to the place to be patched in about 24 minutes. There was no evidence of initial setting or segregation of material and in all respects the transportation of the concrete was successful.

In 1923 a more elaborate central plant will be installed by erecting a bin and using a clam to fill it. A proportioning box will be built and the mixer skip will be filled directly from this box. This will eliminate two and possibly three men at the plant, make the work easier and speed up the patching operation considerably. Incidentally the reason for such extensive patching on the road named was that the road was constructed during the latter days of the World War when traffic demanded a paved surface which had to be constructed under unfavorable conditions.

Accelerated Setting of Concrete—During the summer of 1922, calcium chloride was quite extensively used when making concrete repairs. From 2½ to 3 lb. of calcium chloride to the sack of cement was incorporated in the mix. By doing this a section of pavement that has been patched may be safely opened to traffic in a week and in some cases the patches have taken traffic in four days without any apparent harm being done. The use of such an accelerator is of great value in maintenance work of this nature because of the added convenience to traffic and the short time it is necessary to maintain barricades and lights and detours.

Resurfacing and Widening—Some of the first concrete roads built are not adequate in width for present traffic and occasionally the surface appears to have worn down considerably. Investigation has proved, however, that the wear is only slight even though the road carries a great volume of traffic. The depreciation is due largely to cracking, spalling at the joints and uneven wearing, and any one or a combination of them may necessitate rather extensive work.

A few sections of old concrete roads have been resurfaced with a layer of concrete not less than 3 in. and running to 4 or 5 in. in thickness, the layer being properly reinforced. Although this type of reconstruction has been fairly successful, it cannot be recommended on account of the high cost. A better method would be to widen the existing pavement, if in reasonably good condition, by putting in a strip of concrete at least 2 ft. wide on each side with a curb 6 in. wide and deep enough to take a hot mix bituminous top. This is a problem in reconstruction and will not be discussed.

It is entirely practicable to widen concrete pavements by placing a strip of concrete on one or both sides of an existing slab. Ordinarily there is sufficient shoulder width to widen from 3 to 5 ft. on a side. Care must be taken that the new subgrade is sufficiently solid to support the comparatively narrow strip of pavement. It is best to lower the new subgrade 2 in. below the bottom of the pavement in place and to excavate 4 to 6 in. underneath the old concrete to give it additional strength at the edges.

If the pavement to be widened was rounded off at the edge when built as was sometimes the case, it is necessary to break or cut off this rounded portion to allow for a proper junction with the new concrete. This may be done quite readily with 13-lb. hammers, the laborers working to a chalked line 6 to 8 in. from the edge of the old pavement. Several miles of narrow pavement in Michigan have been widened to 18 and 20 ft. during the past three years and were it not for the longitudinal joints between the old and new sections, the widening would scarcely be noticed.

Surface Treatment—Occasionally a concrete pavement becomes somewhat rough due to excessive cracking or uneven wear of the surface caused by aggregates that are inferior and wear unevenly. Such pavements are sometimes maintained temporarily by surface treatment with a proper grade of refined tar. There is difficulty, however, in securing sufficient adhesion between the bituminous surface and the concrete. Then its initial cost together with the necessity for continuous maintenance throws this particular type of work out of consideration as a general thing. In no case should an attempt be made to put a thin bituminous surface on a new concrete road because it is quite certain to result in a failure.

Before treating an old surface, all cracks, joints and depressions must be repaired as previously outlined. It is important that the surface be thoroughly dry and properly cleaned before application of the tar. Refined tar to be used for this purpose should be applied hot at the rate of about ¼ gal. per square yard, the quality of material being similar to that used for hot treatments on water-bound macadam surfaces. Immediately upon application, cover it uniformly with clean, dry stone chips or pea gravel spread fan-wise with shovels. Care must be exercised that only enough top dressing is added to take up any excess tar and be incorporated into the surface. If warm weather follows soon after the work is done, the surface may bleed somewhat in places. If so, additional chips or pea gravel should be immediately added otherwise traffic will probably pick up the free tar which will result in a partial failure of the treatment. Such a treatment as this will automatically seal over all cracks and joints, yet the seal coat, which should not exceed ¼ to ⅜ in. in thickness, has very little if any, cushioning value. The only valid reason for such a treatment is to smooth up somewhat a concrete surface that has become rough as already stated.

Shoulder Maintenance—It is very common to find ruts in the road shoulders next to the pavement. Unless these ruts are properly taken care of they may become dangerous to traffic and allow water to work underneath the pavement. These ruts form most readily in soil which quickly saturates and hence softens, permitting water to cut deep, especially on steep grades where drivers of horse drawn vehicles use the earth shoulder as a brake by permitting two wheels of their wagon to run off the pavement.

This particular defect should be given the closest attention and if the road is heavily traveled, it is well to construct a strip of macadam or place a few inches of gravel next to the pavement. Many accidents are due to the wheels of a fast moving vehicle being suddenly turned onto a soft shoulder, possibly low and rutted, hence it is of prime importance that the shoulders next to the concrete surface be maintained at the proper height and made substantial enough to support traffic that may be diverted onto them.

Pavement Marking—During the past two years, the practice of marking rural as well as city and village pavements, has become common. Lines from 4 to 6 in.

in width should be painted down the center of pavements to provide lanes, thus serving to divide and direct traffic. This should be done at least around curves, preceding bridges and narrow places in the road on approaches to hills or at any place where there is danger of overlapping traffic.

Costs—Consideration of maintenance costs should take into account the traffic a road is carrying, that is, the vehicle-mile or ton-mile unit of cost should be determined. Such determinations, however, can be made only after a rather complete traffic census has been carried out.

During the past three years in Michigan traffic surveys have been made and in a short time it is hoped to determine, reasonably close, the cost per vehicle-mile to maintain all types of roads on our trunk line system.

A considerable mileage of what might be termed "pioneer" concrete road construction was carried out in Michigan and on account of unforeseen traffic conditions we now have, the maintenance of these first built pavements is comparatively high.

A study of our 1921 maintenance costs on trunk line concrete pavements (eliminating a few miles built during latter days of the World War and a few miles of early construction that should really have been rebuilt rather than maintained in existing condition) reveals the fact that the average maintenance cost per mile for the pavement slab was $365 and $255 per mile for work on the grade including small bridge and culvert repairs and replacements, making a total of $620 per mile. Charges for supervision, markers and signs and snow removal are not included in the above costs.

As the mileage of this type of pavement increases, it is believed that the average slab maintenance cost will decrease, due to better and heavier construction. In a general way it may be said that for a 16- to 20-ft. concrete road well built, it will cost in the neighborhood of $50 per mile annually for filling cracks and joints and a total annual slab maintenance of from $100 to $400 per mile, depending on the amount of traffic.

Zoning and Pavements Paramount in Choice of Convention Topics

In order that an attractive program might be prepared for the Convention of the League of California Municipalities to be held at Coronado next September, ballots containing a tentative list of subjects for discussion were sent to city officials throughout the state requesting them to mark their first, second and third choices. When replies had been received from 90 cities the ballots were tallied, the first choice vote being counted as one, the second choice as two thirds of a vote and the third choice as one third of a vote. The resultant tabulation as published by the League is as follows:

27 Zoning—classifying districts, changing.
17⅔ Pavements—grading, materials, cleaning, repairing.
16⅔ Business Licenses—desirability of, limitations.
16 Sewer Systems—materials, cleaning, disposal methods.
15 Building Codes—fire limits, removing dilapidated buildings.
14⅓ Garbage—segregation, collection, disposal.
11⅓ Public Spirit—how to arouse, civic organizations.
10⅓ Street Lighting—most efficient methods, standards
8⅓ Traffic Problems—street cars, buses, automobiles.
7⅓ Budget Systems—provisions of.
7 Parks and Playgrounds—apparatus, fencing, swimming pools.
4⅔ Pension Systems—scientific tables, rights of pensioners.
4⅓ Fire Protection—alarm systems, apparatus.
4⅓ Public Officials and the Press—commendation, condemnation
3 Street Ornamentation—parking spaces, trees, street signs.
2⅔ Social Service—health centers, relief to needy, etc.
2⅔ Purchasing Agents—powers and duties.
2⅓ Liability Insurance—state of municipal.
1⅔ Billboard Regulation—prohibition, regulation.
1⅓ Municipal Markets—limitations and management.

Maintenance Methods and Costs on Wayne County Roads

Heated Tanks on Trailers Carry Ta. Filler for Day's Operations—Hardeners Mixed With Concrete for Patching

By Leroy C. Smith
Engineer Manager, County Road Commissioners, Wayne County, Michigan

Extracts from a paper read at the annual Michigan Conference on Highway Engineering, Feb. 14, 1923, at the University of Michigan.

IT IS usual to figure maintenance and depreciation on a building at the rate of 2 to 4 per cent annually. I have no knowledge of any concrete pavement costing a greater amount for maintenance. Roads built ten years ago, with a maximum thickness of 6-in., before better practice had been established, required the greatest expenditure. Maintenance costs are also directly in proportion to the intensity of traffic and the weights of the loads. These facts are clearly indicated by the accompanying tabulation of maintenance costs for 1922 of concrete pavements in Wayne County, Michigan.

MAINTENANCE COSTS FOR 1922 OF CEMENT-CONCRETE PAVEMENTS FOR VARIOUS ROADS IN WAYNE COUNTY, MICHIGAN*

Name of Road	Length, Miles	Average Age	Cost of Tarring	Cost of Concrete Patching	Cost per Mile	Average Traffic Per Day	Cost per Vehicle-Mile
Huron River Drive	25.5	8	$759	$1,016	$69	414	$0.00084
Warren Avenue	22.0	3	2,261	1,413	167	1,398	0.00060
Seven-mile Road	31.1	7	3,586	9,523	422	1,482	0.00140
Mack Avenue	7.5	6	284	673	127	2,040	0.00031
River Road	12.5	11	3,860	2,707	525	3,930	0.00067
Michigan Avenue	20.7	11	5,779	4,760	509	4,812	0.00052
Gratiot Avenue	4.3	7	1,136	849	462	5,200	0.00044

* Notes: These figures are based on a 14-hour traffic count per day. Calculations are based upon a 200-day year. Cost per mile does not include maintenance of shoulders, ditches, guard rails and culverts.

As will be noted, thoroughfares upon which there should be 60-ft. pavements, lowered to city grades, with underdrainage, are still being maintained as 16 and 18 ft. concrete roads, none of them more than 6 in. thick. These roads are now carrying traffic of from 5,000 to 10,000 vehicles per day.

Maintenance of concrete pavement involves the tarring or asphalting of cracks and joints, and concrete patching where a considerable area of the pavement is broken down.

Repairing cracks and joints—Three or four times a year it is necessary to apply small quantities of tar or asphalt to the cracks, joints and small abrasions in the surface of the pavement. Central yards are established in convenient locations to supply materials for maintaining 100 to 150 miles of concrete road. These yards are situated adjacent to railroad sidings, so that tar may be purchased in tank-car lots. From the tank-cars it is pumped, or blown by air, into elevated storage tanks of 15,000 gal. capacity. These tanks are provided with steam coils for heating the tar, and are insulated so as to hold the heat. Five-ton motor trailers are provided which will hold from eight to ten barrels. The trailers have kerosene heaters to keep the tar at the proper temperature during the entire day.

The work is so organized that a night watchman heats the tar, fills the trailers and prepares the equipment for use on the following day. In the morning, a tarring gang is able to start out from this central yard with a truckload of dry sand and granite chips and a 10-bbl. trailer of hot tar, ready to go to work. It has been found that the equipment outlined is of about the right capacity to supply a tarring crew of six men for a day.

Cone-shaped distributors are more economical of material than the old-fashioned pouring pot with a fan-shaped nozzle. They are also far more easy to operate in windy weather.

The advantages and economies of the above methods of tar distribution are apparent. The cost of the barrels, amounting to 4 to 5c. a gallon, is immediately eliminated. The cost of h ndling and filling is eliminated for the producer of the bituminous material which is reflected in the price paid for the product. Considerable saving is made in the cost of the distribution of the tar on the road; unloading from trucks, dumping to the side of the road, opening the barrels, filling small tar kettles and heating the material by inefficient methods are eliminated.

Concrete Patching—Where the pavement becomes shattered or is broken down in an area of at least 1 sq.yd. it has to be repaired by some other method than the application of bituminous material and aggregate.

Such holes must be torn out and it is the best practice to waste the broken concrete, not using any of it in making the patch. It is desirable to enlarge the hole to a point where but few cracks radiate from, or circle about it. The excavation should be made at least 1 in. below the old concrete, and the ragged edge should be as nearly vertical as possible, if anything, undercut, so that the patch will give support to the surrounding concrete. No bituminous treatment should be given to the edges of the old concrete.

The best outfit for digging out the old pavement is a large portable air compressor, mounted on a five-ton trailer and driven by a 30-hp. gasoline engine. The capacity of the compressor should be sufficient to furnish 125 cu.ft. of air per minute; this will necessitate a two-cylinder 8 x 8 in. compressor. This equipment is easily transported over any area accessible to motor truck haul. It will furnish air for two large concrete breakers, which have been found very effective in digging out and loosening the old concrete. In fact, three men so equipped will accomplish more per day in removing old concrete than will a gang of twelve men using the old method of sledge, pick, crowbar and jack.

A small 7-S building mixer will mix as much concrete in a day as the air compressor will prepare holes for. Trucks delivering the aggregate and cement to convenient piles along the road and wheel-barrows feeding the mixer and delivering mixed material to the holes are the most common and the most efficient method for the concrete patching job.

Where traffic is heavy, a small central mixing plant is desirable. With this arrangement, a 14-S mixer should be used and should be fed with a batch hopper or bin which can proportion and feed the mix by gravity. The bin should be fed by a small revolving crane picking the material up from piles where it has been previously dumped from motor trucks. The mixed concrete from a central mixing plant can be distributed to the holes in the pavement either by small Ford trucks carrying one batch or by motor buggies. The set-up for the central mixing plant should be made at frequent intervals, say one mile, along the line of the road to be repaired. The great advantage of a central plant is that it does not clutter up the highway with material, cement and equipment, as is the case when the mixing is done with a portable mixer.

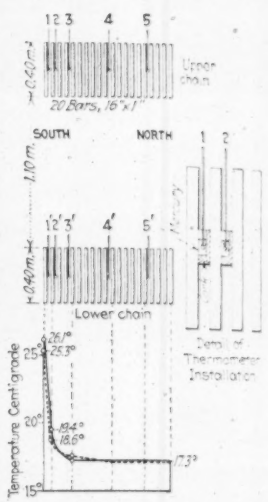
To facilitate traffic it is desirable to tear out and repair only one side of the road at a time, leaving the other side and shoulder free for passing vehicles. Where the hole in the pavement is at the edge, forms consisting of 2 x 8 in. planks firmly staked, or steel road forms, should be used. The patches should be struck off with a strike-board and should be belted—in fact all the first-class methods used in the construction of a new road in the way of workmanship should be employed in making patches. One of the most important things is to build the patch so there will be no unevenness at the junction of old concrete with new.

The use of hardeners such as calcium chloride, Cal and hydrated lime, is recommended in all concrete used for patching. Experience indicates that about 5 per cent by weight is the right proportion. It is admitted that the resulting concrete may not ultimately be so strong, with the use of hardener as without it, but it takes a permanent set so that it is safe to open the patch to travel within a week, instead of holding it closed the usual length of time. This is of so much greater importance than any other consideration that it makes the use of hardeners imperative.

Temperature Variation in Eyebar Chains Found Slight

RESULTS of measurements of temperature differences in the eyebar chains of the Elisabeth suspension bridge over the Danube River at Budapest, Hungary, were recently communicated by Stephan Gallik, chief of the bridge department of the Ministry of Commerce of Hungary, to Ralph Modjeski. They indicate that the effect of heating on the side facing the sun is so slight as to be negligible in stress calculations.

The main carrying members of the bridge are two superimposed chains, each composed of twenty eyebars 16 x 1 in., cut from wide plates. In the tests, which were made a number of years ago, ten thermometers were inserted between the bars of the upper and lower chains, in the positions in the sketch herewith, two in each chain being placed in the spaces nearest the south side of the chain and the other three distributed in the remaining width. At the location of the thermometers the paint was scraped from the sides of the bars, and recessed cork plugs were placed in these spaces so as to form small pockets against the sides of the eyebars. These pockets were filled with mercury and the thermometer bulbs set in this mercury bath. A detail sketch illustrates the arrangement.



TEMPERATURE MEASUREMENTS IN EYEBAR CHAINS

Location of thermometers shown at left. At right is a detail sketch of the arrangement of mercury pockets to receive the thermometers. Two curves at the left represent the average results of readings during two weeks.

Such groups of thermometers were placed at several points along the length of the upper and the lower chain, and readings were taken throughout a period of two weeks. Typical results are plotted in the diagram below the sketch of the thermometer location. The temperatures of the upper chain are indicated by a full line and those of the lower chain by a dotted line.

No marked differences of temperature were found except in the bars nearest the sunny side. The outer bar was from 4 to 9 deg. C. and the adjacent bar 1 to 2 deg. warmer than the mean of all the bars, while from this point inward the temperature was sensibly uniform across the remainder of the width of the chain. Differences in temperature between the upper and the lower chain were very slight, not exceeding 1 to 1½ deg. C. Calculations showed that if the entire upper chain were 10 deg. higher in temperature than the lower chain the stresses would be increased only 9 per cent at the worst point. As the actual difference was less than 2 deg., it was concluded that unequal temperature distribution does not influence the design of the chains.

Increase in Industrial Employees

In 32 out of 43 basic industries there was an increase in the number of men employed in February as compared with January, according to the *Monthly Labor Review*.

O'Shaughnessy Dam Completed and Reservoir Storage Begun

Closure Made at Low Water "in the Dry"—Precast Railing Placed in Short Sections Is to Be Used Again When Dam Is Raised

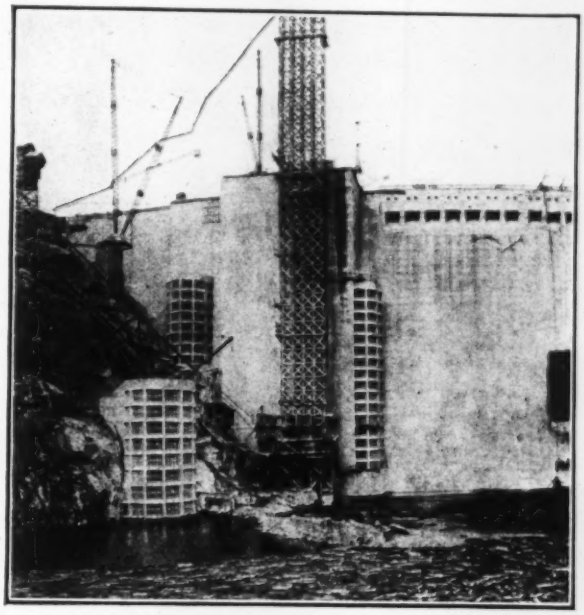
O'SHAUGHNESSY Dam, the name recently given to the main dam on the Hetch Hetchy project (hitherto known as the Hetch Hetchy Dam), which is San Francisco's future source of water supply, has been completed except for a few minor details and was accepted by the city as of March 28. Closure of the temporary flood passageway through the dam was made March 12 and the stream flow was then discharged through valves in the bypass tunnel until the last of the construction equipment could be removed from the valley. Storage is now accumulating in the reservoir.

Under the terms of the Hetch Hetchy grant the 250,000 acres in the Modesto and Turlock Irrigation Districts are entitled to a specified flow taken to represent approximately the natural flow of the stream and this natural flow must be allowed to pass the dam whenever the irrigation districts can use it to advantage. The bulk of the storage is to be taken from flood waters. Records show that in May and June floods often bring enough water in two weeks to fill the 206,000 acre-ft. capacity of the reservoir.

The dam has been built by the Utah Construction Co. to whom the contract was awarded in August, 1919. There have been five 90-day extensions of the original contract and until the exact status of bonus and penalty conditions has been determined, the exact amount of payment under the contract cannot be stated. It will, however, approximate a total of $6,000,000 exclusive of the valves and gates which were furnished under a separate contract.

The accompanying illustrations show the yardages placed in the dam in the successive months of the construction period. The dam is arched on a 700-ft. radius and the first construction stage just completed brings the structure to a total height from foundation to crest of 341 ft. The dam is 298 ft. thick at the bottom and 600 ft. long on the crest. A description of the construction plant and program appeared in *Engineering News-Record*, Sept. 21, 1922, p. 464.

The recently closed temporary passageway through the dam had its upper end tapered from a 12 x 13-ft. section at the upstream face to a 12 x 12-ft. section, 32 ft. from that face. The natural stream flow had been passing through this passageway since being diverted from the bypass tunnel to permit placing therein the three 36-in. valves and the concrete plug in which they are embedded. When closure of the dam was to be made the valves in the bypass tunnel were opened and the flow was made to pass trough them by means of small diversion dams thus making it possible to work



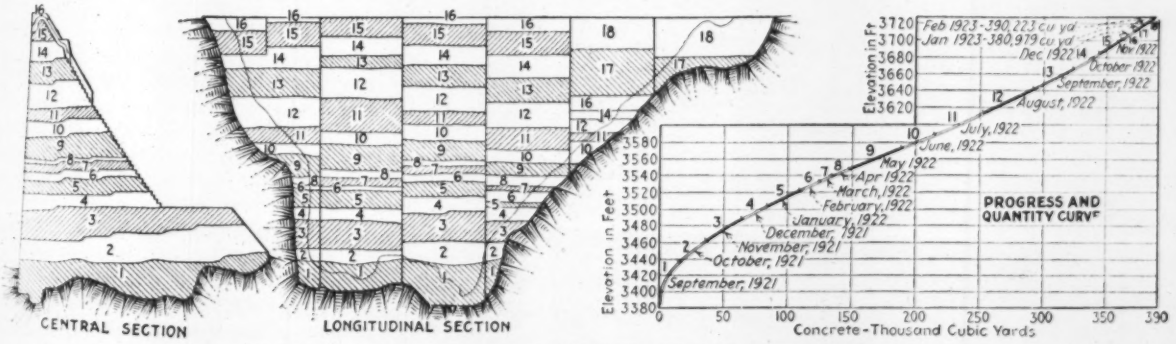
UPSTREAM FACE WITH STORAGE ACCUMULATING

Bypass tunnel intake racks at left, above them is the intake for the other three 36-in. valves. Racks in the center mark the intake for six 60-in. valves. Gunite is being applied. The railing is partially in place. Tower and concrete plant being removed. Floating debris is cordwood from clearing contracts.

"in the dry" in plugging the temporary passageway through the dam. Only the 32-ft. tapered section was plugged, the remainder of the passageway through the dam was left open and will serve as an outlet from the various drains and inspection galleries through the structure.

All the control equipment, consisting of six 36-in. valves for regulating the flow into the aqueduct and six of 60-in. diameter for controlling the flow of water released for the use of the irrigation districts, are in place ready for service. All these are the Larner-Johnson balanced valves.

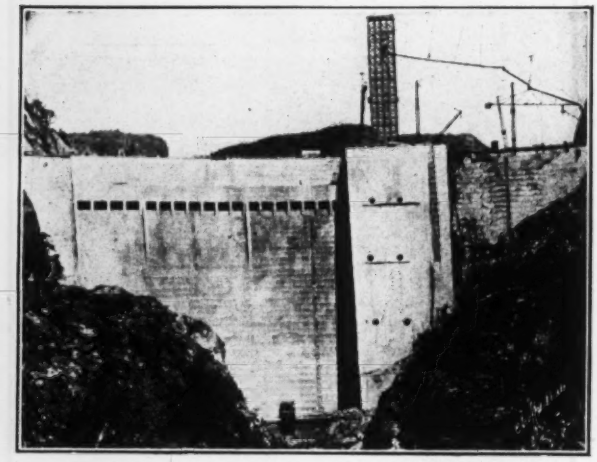
When the dam is later raised the additional 85 ft. contemplated in the original plans, the bank of eighteen 10-ft. siphon spillways on the crest will be filled with concrete. The railing was placed in precast sections



PROGRESS RECORD BY MONTHS ON O'SHAUGHNESSY DAM, HETCH-HETCHY PROJECT

between posts 16 ft. apart. The posts are grouted into reinforcing bars projecting from the crest of the dam, but at least the panels are to be removed and used again on the crest at higher level when the dam is raised.

The work has been done under the direction of M. M. O'Shaughnessy, city engineer of San Francisco. At the dam C. R. Rankin has been resident engineer for the city and A. E. Paddock has been resident engineer for the contractor.



DOWNSTREAM FACE OF O'SHAUGHNESSY DAM

At the base appears the outlet of the temporary passageway that is now the main drain. Outlets of the six 60-in. valves are seen in the thicker section which indicates thickness of the structure when the additional 85 ft. is added to the height. Outlets of three 36-in. valves are close to the rock at the right.

Microbiology and the Theory of Activated Sludge

An Editorial Discussion Reprinted from "The Surveyor," London, England, for March 9.

MICROBIOLOGY and the theory of activated sludge were dealt with recently by Dr. A. M. Bushwell and Mr. H. L. Long in a paper published in *Engineering News-Record*. The paper is especially interesting, as it shows the order in which the protozoa make their appearance during the maturing of the activated sludge. There are, however, one or two statements made which are based on papers of other authors that are open to criticism. While it is true that Dr. Fowler considers the process to be partly due to a clotting action, he cannot be said to state that the process is a mechanical one, for in the same paper he definitely states that in his view the process is entirely due to bacterial activity. With regard to Ardern and Lockett's work, although they state that nitrification does take place provided that aeration is carried on for a long enough period, it appears that clarified or clear effluents are produced without the phenomenon of nitrification taking place. The final oxidation to nitrates is possibly desirable as a safeguard.

It is perhaps true that the organism M 7 is the only one that has been specifically mentioned in connection with the activated-sludge process, but it should be remembered that this organism was not isolated from the sludge or sewage, but from a canal. It does not appear that this organism has ever been found in activated sludge; the way in which this organism acted was held to explain to some extent the action of activated sludge. Ellis, in "Iron Bacteria," questions the work, and doubts whether this organism, which was described by Mumford in the *Journal* of the Royal Sanitary institute, is an iron organism, and whether it has the power of oxidizing iron compounds or of secreting an enzyme. It must be remembered that the organisms which occur in sewage have been largely investigated and isolated, and such organisms will occur in activated sludge. B. proteus vulgaris, B. pyocyaneus, B. Florescens liq. and others have been isolated from a sewage plant dealing with activated sludge. These were all found to break down nitrogenous organic compounds.

The authors of the paper say that a miscroscopial examination of the sludge does not reveal the presence of adsorbed matter, and that the particles "are composed entirely of active growing microscopic organisms." It is, however, a fact that in the examination of many samples of activated sludge it has always been found to consist of debris surrounded by bacteria and protozoa. One would hardly expect such an examination to reveal the presence of adsorbed colloidal matter. The action probably is somewhat as follows: The sludge, on being agitated with the sewage in the tank, adsorbs on the surface particles of colloidal matter, in this way clarifying the sewage. The organisms, particularly the bacteria, feed on adsorbed matter, there reducing it. The protozoa feed on the bacteria and also on the organic matter present, and thus the process of purification by activated sludge is brought about by physical and biological means.

[The foregoing comments were submitted to Dr. Buswell, who has supplied the following remarks—EDITOR.]

The authors of the article referred to in the editorial from the *Surveyor* reprinted above wish to call attention to the following two points:

1. The sewage organisms, B. proteus vulgaris, B. pyocyaneus, B. Florescens liq. mentioned as having been isolated from a sewage plant dealing with activated sludge, are all liquefying organisms and if present would tend to undo the work accomplished by the sludge in changing dissolved and colloidal organic matter to an insoluble state. Our object has been to emphasize the importance of organisms which synthesize rather than peptize, since they will be sludge formers.

2. We do not wish to be understood as claiming that there is no physical or mechanical phase to the reaction. We do believe, however, that the biological phase offers the more fruitful field for research at the present time. We have compared the activated sludge process to the disposal of garbage by feeding it to hogs, realizing that the mechanical collection of the garbage is an important part of the process but meaning to point out that it would not be successful unless the herd of hogs were cared for by a trained attendant preferably under the supervision of a veterinarian. Considerable is known concerning the care of hogs but very little is known concerning the organisms essential to the activated sludge process, the sludge formers.

Sacramento Garbage Being Fed to Hogs

The garbage incinerator at Sacramento, Calif., was closed last October and a start made on disposal by feeding to hogs on land rented by the city. The city collects the garbage and delivers it to the hog farm, with average haul of two miles. The contractor supplies the hogs, which must weigh not less than 80 lb. each when delivered to the farm, and carries on all the work and does all the business required. When the contractor sells the hogs he pays the city the sale price for one-third of the net gain of the hogs in weight. The contractor started with 300 hogs on Oct. 9 and expects to increase the number to at least 1,200. The material not consumed by the hogs is to be scraped up, dumped into large holes and covered with earth. According to estimates made by H. C. Bottorff, city controller of Sacramento, the city will make a net profit of $1,200 a year on the contract by this plan and in addition will save the $13,500 a year which it has cost to operate the garbage incinerator. The population of Sacramento by the census of 1920 was 65,908.

City Controls Sub-surface Use of Public Streets

New York Borough Builds Since 1915 400 Miles of Under-surface Structures to Standard Plans —Complete Records Kept

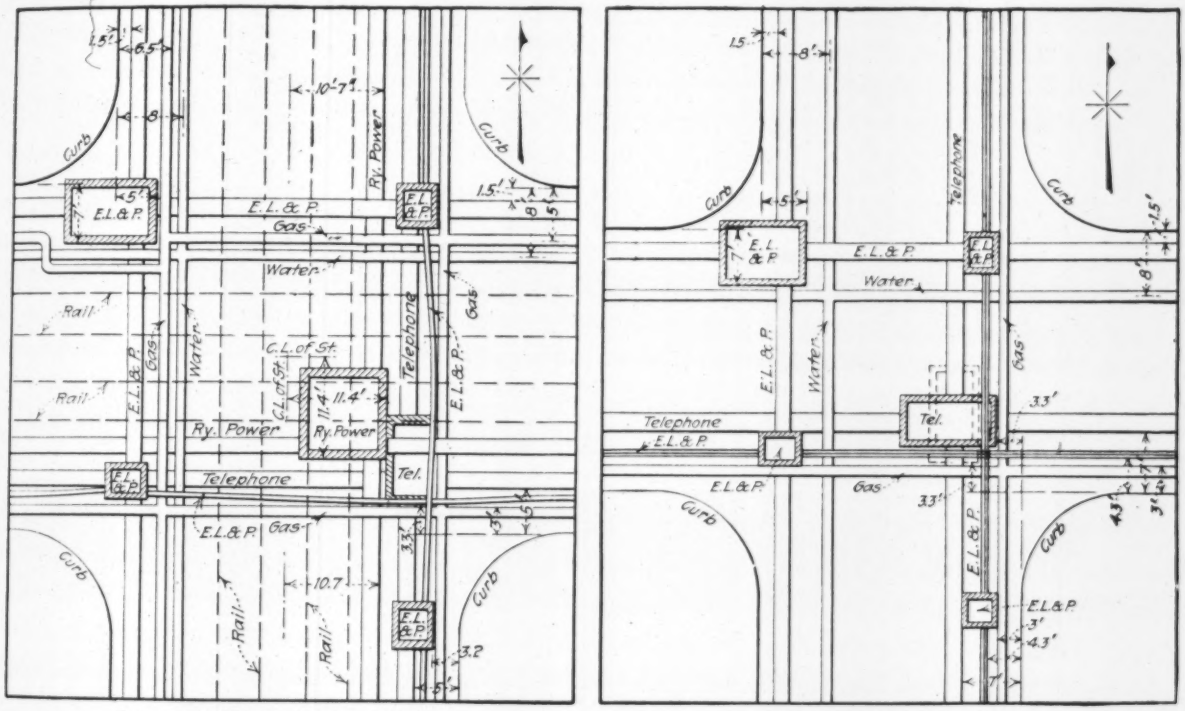
By Charles U. Powell
Chief Engineer, Topographical Bureau, Borough of Queens, New York City

PROFITING by the experience obtained in the other more intensely built-up boroughs of the city of New York, the Borough of Queens in 1915 undertook to control the sub-surface use of its highways. Careful studies were undertaken, and a lane chosen for each class of sub-surface structure, so that regardless of the sequence of construction, a given structure is always located in the same relative position in the highway. The locations of all the lanes were determined with a view to the greatest economy of construction and a minimum mutilation of street pavement, as well as to economy of space.

In the beginning, the adoption of a standard plan was resisted by some of the public service corporations; while those responsible acknowledged the advantage of the general scheme, the standard plan did not in every case work out with the greatest economy to each structure. Wherever a structure can be more economically installed by a departure from the standard treatment, requests are made for special consideration. Consideration is always accorded, but unless a great saving can be effected, the standard plan is insisted upon.

There are, however, several instances of departure from the plan for good reason. For example, in the case of a street bordering upon a public park, where the standard gas pipe lane was on the side of the park, the gas company was permitted to depart from the standard plan and place its pipe on the inhabited side of the street. By this the need of house connections crossing the street, and the resultant damage to pavement was avoided. Likewise, in a few instances where it became necessary to join new work with existing structures built prior to the standard plan, departure was permitted to avoid a needless kink in the pipe or duct lines, but this variation is always limited to a single city block. Trolley tracks in a street also in some cases influence the location of the sewer and other substructures. The result is that of the 442 miles of sub-surface structures built in the streets of Queens Borough since the adoption of the standard plan in 1915, more than 400 miles have been built in accordance with the standard plan.

The accompanying drawing indicates the standard location of pipes, ducts, boxes, and manholes for the various structures in a roadway 40 ft. or less in width, and likewise the treatment in roadways of width greater than 40 ft. It will be noted that no sewer location is shown upon the plans. The usual location of the sewer is in the center of the street, but sometimes it is on both sides of the center in wide streets where there is more than one line, and also where large trunks occur along a street with trolley tracks. The hand holes, drip boxes, and water gate locations are not standardized, it being permissible to place these where convenient outside the areas reserved for manholes and pull boxes standardly fixed upon the plans.



STANDARD LOCATION FOR SUBSURFACE STRUCTURES IN QUEENS BOROUGH STREETS

To enforce the standard plan it was necessary to control the various corporations placing structures in the streets. The method of control exercised, in the absence of definite laws giving the Borough President jurisdiction over the placement of substructures, has been to

require the approval of the Substructure Bureau before permits to open highways for construction are granted. A public service corporation desiring to place a pipe or duct line has since the adoption of the Greater New York Charter been required to obtain from the office of the President of the Borough a permit to open the street. The Highway Bureau, which issues these permits, has since the adoption of the standard, required the approval of the sub-surface bureau before issuing permits. Thus, in a somewhat back-handed way, the various companies are made to conform to the plan. In the course of the first year cordial co-operation was obtained, for it was learned by experience that the plan in the long run worked for the interests of all. From the very start the various bureaus of the borough and the water department of the city agreed to the standard plan, and helped to realize it.

The Bureau of Substructure is a division of the Topographical Bureau of the Borough, which, under the jurisdiction of the President of the Borough, Maurice E. Connolly, is administered by the engineer in charge of the Topographical Bureau, through the assistant in charge of Substructure Division, Thomas P. Cunningham. Thus the Topographical Bureau designs and controls the development of the streets of the borough, both horizontally and vertically (location and grade) and it also controls the sub-surface use of the streets.

Progress in the Classification of Engineering Positions

Committee of the A.A.E. on the Classification of Positions in Engineering Makes Encouraging Progress

By A. B. McDaniel
Member, Civilian Advisory Board, General Staff, War Department, Washington, D. C.

In the decade preceding the World War, great material development and prosperity had bred a general feeling of smug satisfaction in this country. We contented ourselves with the happy thought that the schools were educating the young, the great "melting pot" was assimilating the immigrants of many nationalities and welding them into one homogeneous body, and the industries were developing a contented and efficient army of workers. This illusion was rudely shattered by the selective draft with its revelations of physical subnormality of nearly one-half of the men drafted, of illiteracy to the extent of practically one-fourth of the men examined, and of deficiency in trade skill among one-third of the men tested.

This startling condition of unpreparedness necessitated the setting up, by the War Department, of an emergency training program, which included the instruction of 130,000 men in 147 schools in 67 different lines of technical work, the establishment of the Students Army Training Corps in the colleges and universities, and the development of a new system of educational training, comprising the following steps: (a) The accurate definition of every job to be done; (b) the determination of each man's special abilities; (c) the allocation of men to the jobs in accordance with their predetermined abilities; and (d) the development of the ability to master the assigned job as rapidly as possible.

With the aid of hundreds of the leading educators, psychologists, engineers, and technical experts of the country, the government developed a system of educational training based on the principle of "learning by doing." This motivated form of instruction was productive of excellent results in the intensive training of men in the various occupations and trades required by the non-combative arms of the military establishment.

Early in the development of the army training, it was found that the first step in the preparation of courses of instruction was the detailed determination of what the men must be trained to do. This discovery resulted in the preparation of brief statements of descriptive qualifications or minimum specifications for the various positions for which men were being trained.

Carnegie Foundation Report—Several years ago the engineering report, made by Dr. C. R. Mann for the Carnegie Foundation for the Advancement of Teaching, in co-operation with the four founder engineering societies, recommended that a study be made to ascertain just what topics should be taught to increase the efficiency of our educational plants and to improve the character of their product. Special emphasis was laid in this report upon the importance of determining the topics common to all branches of engineering.

This report aroused much discussion among educators and engineers as to the length of courses of instruction and the nature and amount of subject matter that should be included in our technical curricula. A great variety of suggestions have been made as to the number and combinations of general and technical subjects that should be used. But after several years of fruitless discussion, no general agreement has been reached and little progress has been made towards this important study.

In any educational program, it is of prime importance that the objective for training be clearly defined. Unless we know where we are going, but little progress can be made. Thus it is obvious from our recent army experience that the basic work is the clear specification of the results to be accomplished. This plan is so very obvious and simple that one wonders that educators have not put it into practice long ago. But, it must be remembered that the necessary analysis must be made among the practitioners in the office and field, and cannot be done by overworked teachers in the classroom and laboratory.

Such an analysis was initiated by industry about a year ago in three of the larger manufacturing centers of the East. An analysis of several positions in different plants in the same city indicated that it was possible to determine the basic requirements and prepare minimum specifications which could be used by these concerns in the selection, assignment, and promotion of employees. Although the general policies, methods of organization and local conditions introduced special requirements for the same positions in different plants, it was found that the basic requirements of any position were the same in all the plants. This discovery, which substantiated the results of similar work carried on in the army during the past five years, makes it possible and logical to prepare statements of necessary qualifications which comprise minimum requirements. In one large industrial center, the classification work has proceeded with such success, that the industries have secured the co-operation of the local chambers of commerce, the public school system, and local

educational institutions with a view to the preparation of a suitable training program which will be based upon the results of the classification study now being made.

Work of A. A. E. Committee—Several months ago the American Association of Engineers appointed a committee of engineers and educators to make a study of the engineering field with a view to the classification of its various positions. The committee has started its work in the highway engineering field and has secured the co-operation of the U. S. Bureau of Public Roads, and several state and municipal highway commissions and bureaus scattered throughout the country. The committee is securing data from about a thousand highway engineers in the various positions from chainman and rodman to district or division engineer. These data are accompanied by typical problems, which illustrate the basic requirements of the various positions. For example, the problems furnished by any position, such as resident engineer, indicate the nature and amount of mathematics, language, pure and applied science, economics, law, accounting, etc., as well as the executive, supervisory, manipulative, and technical abilities required.

The minimum specifications for the different positions are being prepared after a compilation and a thorough study of the data, received in the occupational study sheets. These specifications clearly and briefly state the minimum or basic requirements as to the things a man must be able to do, the things that he must know, and the personal abilities and qualities which he must possess in order to fulfill the demands of the position. The local conditions of climate, topography, transportation, organization policies and systems, etc., will often introduce special features in many positions. Past experience has indicated, however, that for any position, the basic requirements are practically the same in different organizations and in different parts of the country.

The experience of the army in the selective draft, of industry in its personnel service relations, and of a large number of employment bureaus, licensing boards, civil service commissions and similar agencies, clearly indicates the wide field of use of minimum specifications for the proper selection, assignment, promotion and transfer of workers in all fields of labor. As time goes on, experience emphasizes the need of these fundamental instruments for the proper allocation of personnel, so that it may be possible to fit "round pegs into the round holes" with a minimum expenditure of time and energy.

Engineering educators and practising engineers are generally in accord that our technical courses should train students in the fundamental elements of the profession. Also, there seems to be a general agreement as to the importance of providing a suitable background of training in subjects of a general or cultural nature. Undoubtedly the work of the Committee on the Classification of Engineering Positions will be of definite assistance to educators in pointing out the fundamental elements of technical training. The practitioners in the engineering field intimate that more time and attention should be given in engineering curricula to humanistic subjects. It is evident that the technical schools should give careful consideration to the possibility of providing some instruction in economic principles, business relations and industrial organization. The large number of engineers who are enrolled in correspondence schools giving instruction in economics, business administration and similar subjects shows that the engineers above the mere technical grades, require a thorough grasp of social, economic and business principles.

The work of the committee, even in this preliminary stage, points out the importance of a thorough study of the present status of engineering education. Are the engineering schools of the country turning out only narrow-gage technicians? Should not the engineering curricula provide for a broad fundamental training in pure and applied science with a suitable background of the humanistic studies? Are the technical schools fulfilling their entire function if some provision is not made for the direction and guidance of the young men and women who leave their cloistered halls to enter the arena of life? In order to answer these questions properly, is it not necessary to have fundamental data, which can only be secured from careful job analyses and minimum specifications made by the practitioners in the profession, who know the actual requirements of the work?

The report of the Committee on the Classification of Engineering Positions will be available some time in May.

Seepage Losses From Mackay Reservoir

By Lynn Crandall
Watermaster, Big Lost River, Mackay, Idaho

IN CONNECTION with the administration of the waters of Big Lost River, Idaho, for the past few years, records have been collected showing the seepage losses through, under and around the Mackay dam. Conditions at the site of this dam, together with the results of experiments on models and a proposed design for a dam at the site, are given in detail in the *Transactions* of the American Society of Civil Engineers, Vol. LXXXI, December, 1917, page 1.

The dam as built and now in use consists of a gravel fill about 70 ft. high at the point of maximum height. It has a top width of 174 ft., an upstream slope of 3 to 1 with a facing several feet thick of fairly fine material, a downstream slope of about 1½ to 1 riprapped with heavy rock. The storage capacity at a gage height of 64 ft. is 41,000 acre-feet. Usually the gates at the dam are closed tight during the winter months and the discharge at the measuring station two miles below the dam at such times is shown in the following tabulation:

TABLE I—DISCHARGE IN SECOND-FEET AT GAGING STATION BELOW MACKAY DAM WITH GATES AT DAM CLOSED

Gage Height, Ft.	1918–1919	1919–1920	1920–1921	1921–1922	1922–1923
10	...	...	43	50	...
15	...	...	47	52	...
20	68	...	59	63	...
25	76	...	69	75	...
30	87	85	85	84	...
35	94	94	100	95	97
40	111	...	122	103	102
45	121	...	135	112	106
50	137	...	...	135	113
55	...	...	...	...	123

Records for all stages each season are not complete as the gates were partly open at times, and no records at all are available for gage heights over 55 ft. as stages in excess of this amount have only been attained during the flood period when the gates are partly open to pass water needed for irrigation. About 25 per cent of the discharge shown appears in the river channel immediately below the downstream toe of the dam; the balance flows into the river at various points between the dam and the gaging station. No time interval was used in preparing this table, the discharge in each case being the discharge on the particular day when the reservoir reached the indicated gage height.

Gravity Freight Yard at Canton, Ohio; W. & L. E. Ry.

Single Switching Incline Without Hump Classifies Traffic in Both Directions—Scale on Incline—Engine Terminal With Turntable—Repair Tracks

THE revision and enlargement of the Gambrinus freight yard and engine terminal of the Wheeling & Lake Erie Ry. at Canton, Ohio, is a good example of improvements needed or being made at division points on many railways in order to facilitate the handling of increased traffic. In this case the work includes relocation of main line, construction of additional yard tracks, introduction of gravity switching and the construction of a new engine terminal. Topographical conditions permit of gravity movements without the construction of a "hump" to give the necessary grades.

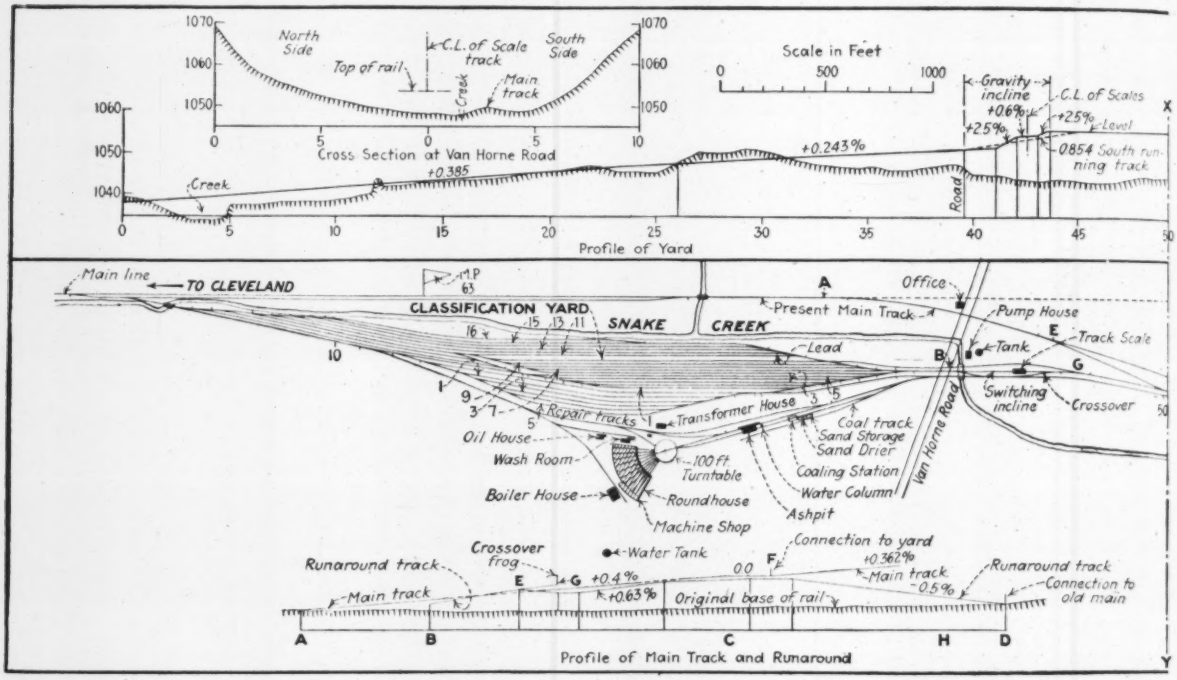


FIG. 1—LAYOUT OF FREIGHT YARD AND ENGINE TERMINAL OF

The Gambrinus yard at Canton was established originally in 1917-1918, and is a division yard on the main line from Zanesville to Cleveland, Ohio. Although the railway runs practically north and south it lies in an east and west direction through Canton, as indicated by the plan, Fig. 1. On the divisions served by this yard the ruling grades are 0.5 per cent. Fig. 2 is a view looking east, with the coaling station and engine terminal at the left and the classification yard at the right.

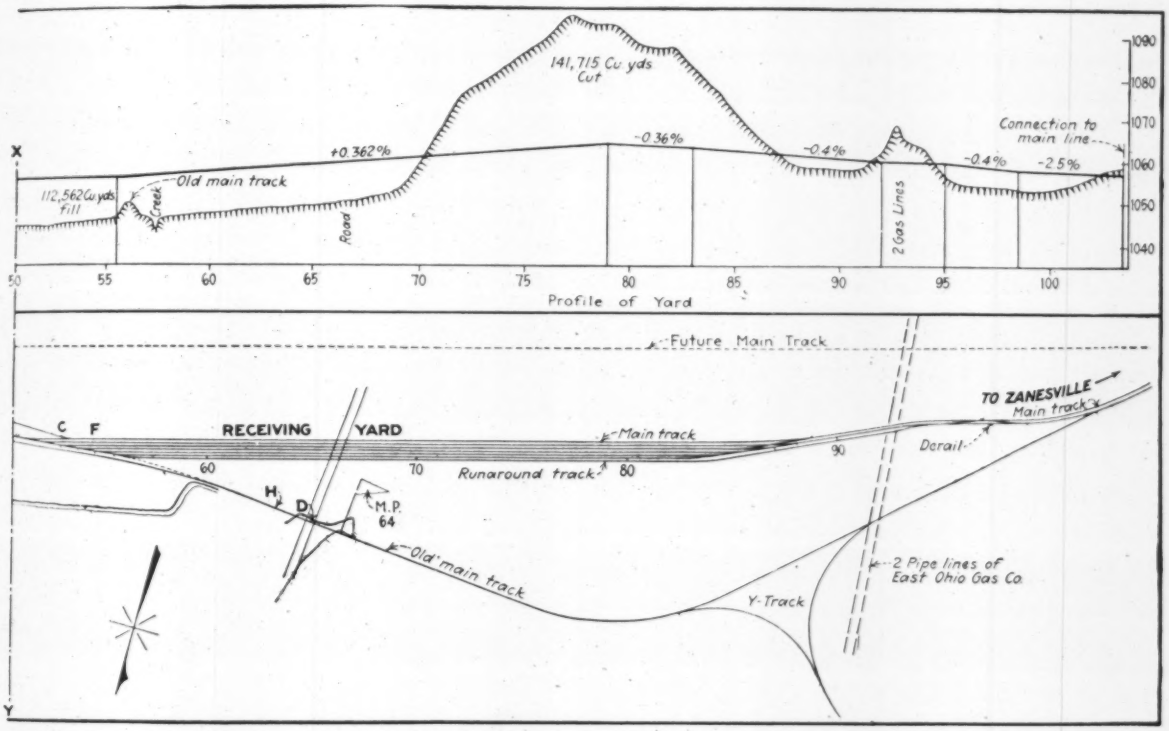
Traffic Conditions—As in most cases of this kind the design of the improvement was governed largely by traffic and operating conditions. At the Gambrinus yard there are ordinarily about six trains daily in each direction. Coal represents 60 per cent of the northbound traffic, while the southbound movement consists mainly of miscellaneous freight. Practically all inbound trains are broken up, the cars being classified for various destinations and for local distribution. A few solid trains are run through, with only a change of engines and filling out with additional cars on account of change in tonnage rating. Standard tonnage trains are rated at 3,060 tons (loaded cars) northbound and 2,400 tons (loaded and empty cars) southbound, the number of cars being fifty in each case. The average number of cars switched daily is 225 northbound and 200 southbound. About 30 "bad-order" cars and 75 "hold" cars are switched out daily.

Yard Layout—In the original location the main track from Zanesville ran north of the receiving yard in a long curve and then crossed the head of this yard, continuing along the south side of the classification yard. In the recent revision, one of the new tracks on the south side of the receiving yard is utilized as the main track, thus avoiding the crossing of yard tracks. When additional receiving tracks are required a new and direct main track will be built on the location indicated by a dotted line in Fig. 1. The old curved main track, with its wye for turning engines, will be retained, but instead of crossing the yard tracks it will lead into the engine terminal.

Since the heavier movement is east and northbound, the layout is planned with a special view to the handling of traffic in this direction. In the general plan there are two yards in tandem connected by the gravity switching track or incline and by other auxiliary tracks. Northbound trains enter a receiving yard having seven tracks for 62 to 84 cars. The north track is a thoroughfare or running track and at present the south track is utilized as the main track, but future widening of the yard will be on this latter side. Beyond the gravity track is the classification yard, with fifteen body tracks

for 165 to 210 cars each and two leads or running tracks. Southbound trains from Cleveland also enter the same receiving yard, since there is a gravity switching track in one direction only and the classification yard serves for traffic in both directions.

Yard tracks are laid mainly with 90-lb. rails and gravel ballast. Body tracks are spaced 14 ft. c. to c., and ladders or running tracks are 20 ft. c. to c. from body tracks. Frogs are mainly No. 8. All switches are operated by hand. A caboose track is arranged parallel with the gravity incline track, and parallel with this also is a runaround track for bypass movements of cars or trains through the yard. The main line is single track, but at each yard entrance a freight lead track about 4,000 ft. long is provided, so that trains



WHEELING & LAKE ERIE RY., AT CANTON, OHIO, AND PROFILE OF YARD

destined for the yard can be kept clear of the main track. For night work the yard is lighted by flood lights mounted on the coaling station, the roundhouse and a highway bridge which spans the gravity track.

A considerable amount of grading was required for the additions to the yard layout. This included a deep cut of 141,700 cu.yd. and a fill of 112,560 cu.yd. for the receiving yard and its connection with the classification yard, but the latter yard required only light filling. The main track from Zanesville approaches the yard on an ascending grade of 0.7 per cent and yard tracks rise from the main track connection on a grade of approximately 0.4 per cent which continues into the receiving yard. Beyond this the grade falls at 0.36 per cent to the end of the ladder, whence there is a level stretch to the gravity incline. From the foot of this incline a descending grade of 0.243 and 0.385 per cent extends to the main track connection and continues on the main line.

Gravity Switching—An unusual feature is that although the switching for classification of cars is by gravity movement there is no actual hump, the yard being so graded that all movements for classification are on descending grades. Thus the usual ascending grade to the summit of a hump is absent in this case, as will be seen by the profile in Fig. 1. From the head of the gravity incline there is an accelerating grade of 2.5 per cent for 25 ft., followed by 50 ft. of 0.6 per cent, on which the 150-ton track scale is located. Thence a second accelerating grade of 2.5 per cent extends 50 ft. to the head of the classification ladder. In the classification yard the grade is 0.243 and 0.385 per cent.

It is not the practice to uncouple every car at the head of the accelerating grade, cuts of cars for the same destination being switched at one movement and weighed automatically in passing over the scale. The speed averages 8 m.p.h. on the first grade, 6 m.p.h. over the scale and 10 m.p.h. to the head of the classification ladder.

Yard Operation—In the receiving yard at the west end, the road engines are cut off and proceed past the hump by a runaround track on a grade of 0.834 per cent to the engine terminal. When the train has been marked or carded a yard engine pushes it to the head of the accelerating grade for classification. The caboose is placed on a second runaround track, south of the hump, ready to be switched to an outbound train. Outbound trains for both north and south movements are made up on certain tracks of the classification yard which are assigned as departure tracks. These tracks are equipped with compressed air piping for testing the train brakes before the road engines are attached.

For a switching service of about 425 cars daily (including both directions) five yard engines are required for the 24-hour day. About thirty bad-order cars

daily are switched out and moved to the repair tracks. About seventy-five "hold" cars are also switched out daily and moved to assigned tracks in the classification yard to be held awaiting orders for further movement.

As an example of the way in which yard tracks are assigned, the following list is given:

Repair Tracks: (1) Cars for train No. 190 (which

FIG. 2—CANTON YARD AND ENGINE TERMINAL

is a fast freight), (2) coach repairs, (3 and 4) bad-order cars, (5) repair track at present occupied by wrecking train. Classification Tracks: (1) and (2) "Hold" cars and cars for B. & O. R.R. and for local industries and team tracks in the Allen St. district; (3) merchandise cars for the Canton freight house and for local industries in what is known as the middle district; (4) cars for South Canton; (5) cars for United Furnace Co. and United Alloy Co.; (6) branch local and swing cars; (7) and (8) empty box cars in reserve, for prospective loading; (9) cars for Pennsylvania R.R.; (10) cars for Berger Co. and north end industries; (11) a lead or thoroughfare track; (12) northbound local cars; (13) cars for Akron, Cleveland & Youngstown Ry; (14) cars for Kent; (15) and (16) cars for Cleveland.

Engine Terminal—About twenty road engines have to be cleaned and served daily at this point in addition to the five yard engines. For this service a compact engine terminal is provided, having approaches from each end of the yard, as shown in Fig. 1. The east or main approach has two tracks leading to the turntable and a third stub track for coal and ash cars. Both of these engine tracks are served by a coaling station, a water column and a double ashpit.

The 100-ft. turntable is of the continuous girder type, supported at the center and at each end, thus eliminating the necessity of spotting the engine in position as on the balancing type of turntable. There is said to be also less shock in moving the engine on and off the turntable. A 300-hp. motor is geared to the carrying wheels at one end and the turntable can be moved through a complete revolution in 90 seconds. The ten-stall roundhouse is 115 ft. deep, except that for a space of four stalls it is 135 ft. in order to provide a machine shop.

This building has walls of brick and steel sash, with a timber roof having beams supported on interior columns. Other facilities include a service building for the yard crews and trainmen, a wash room, foreman's office, transformer house, power house and a boiler house for heating the other buildings. A second water column serves the two approach tracks from the east end of the yard. Water of good quality and not requiring treatment is pumped from wells to two elevated steel tanks of 100,000 gal. capacity each.

Two engine tracks are served by the coaling station, Fig. 3, one track passing under the bin and the other at one side. On the opposite side is the coal car track with track hopper. This coaling station is of timber construction and has its 200-ton bin divided into two compartments in order to handle different grades of coal for hand-fired and stoker-fired engines. The spouts discharge vertically and are so hung as to have considerable lateral play in order to prevent damage if struck by an engine while being spotted in position or started. Coal cars on the stub track dump their contents into a hopper from which the coal is fed by automatic charging scoops or loaders into the two 1-ton buckets, each bucket being operated by a balanced electric hoist. Timing devices insure that the loaders and buckets work in harmony. Since the hoist is operated by a worm gear the bucket cannot run away or overhaul. From 500 to 600 tons of coal are handled daily. The sand drier has a 10-ton bin and can dry ten tons per day. Compressed air forces the sand through pipes for delivery to the engines. This coaling and sand plant was built by the T. W. Snow Construction Co., Chicago.

A double-track water-filled ashpit which is provided for cleaning the engine fires is of reinforced concrete and has its side slopes lined with paving brick laid on a 1½-in. mortar bed and held in position by shelf angles, as shown in Fig. 4. Each track has one rail laid on the wall of the pit and the other carried by a pair of I-beams supported on posts spaced 5 ft. c. to c. These posts are of 18-in. cast-iron pipe filled with concrete

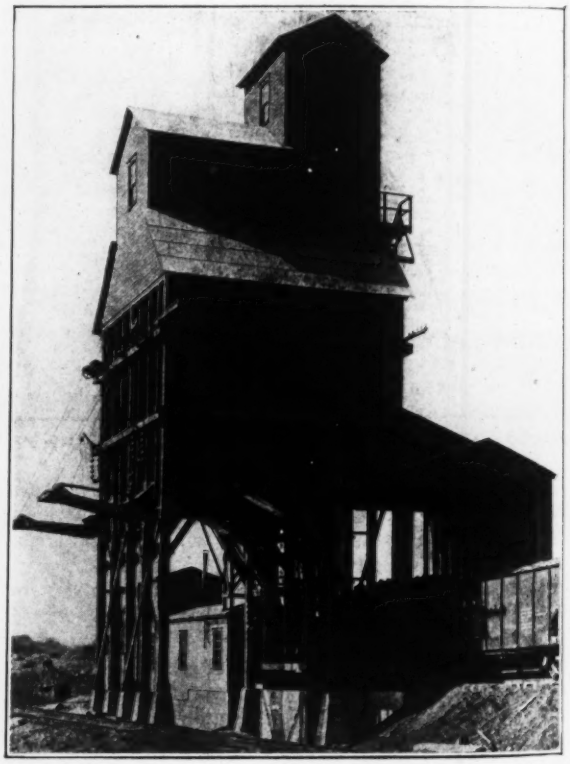


FIG. 3—COALING STATION SERVES TWO ENGINE TRACKS

and seated in concrete pedestals. A 4-in. water pipe enters one end of the pit and at the other end is an overflow elbow on an 8-in. outlet. This elbow arrangement is considered less liable to obstruction by refuse than an opening in the end wall. The two engine tracks on the ashpit are spaced 18 ft. c. to c. and at one side is an ash track spaced 16 ft. from the engine track for

the use of a locomotive crane which removes the ashes with a grab bucket at convenient intervals. It was planned originally to handle the bucket from a gantry crane spanning the three tracks, but the present arrangement is simpler and less expensive.

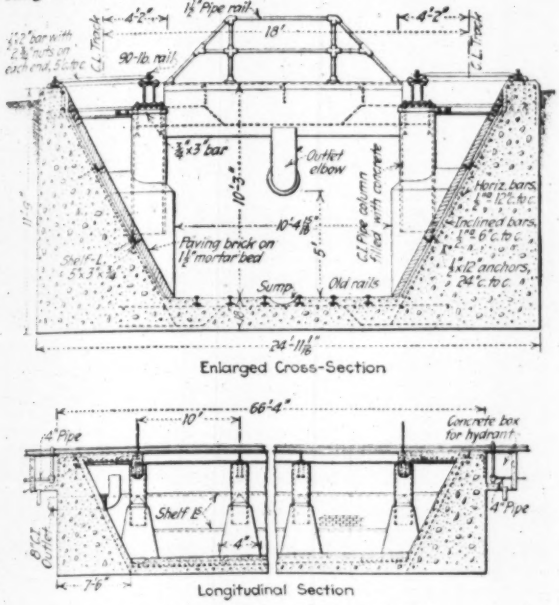


FIG. 4—WATER-FILLED ASHPIT

The design and construction of the Gambrinus yard and engine terminal were carried out under the direction of W. L. Rohbock, chief engineer of the railway.

Removing Seepage and Alkali from Irrigated Lands

Excess Water in Soil Gives Engineers Technical and Social Problems in Protecting and Developing Reclaimed Areas

By D. W. Murphy
Consulting Engineer, Los Angeles, Calif.

A PECULIARLY difficult problem which arises in the maintenance of lands reclaimed by irrigation in the arid districts of the West is the liability of these lands being damaged by the accumulation of an excess of water in the subsoil and the consequent gathering on the surface of earthy salts, commonly called "alkali," to such a degree as to prevent profitable crop production. This difficulty is accentuated by the fact that it is not purely of an engineering character, but is so interwoven with social or economic considerations that the engineer must have something more than technical ability in order to deal with it. He must be able to secure the confidence of the people and without alarming them unduly to convince them of the necessity of providing for conditions which may not be apparent for months or years.

It is safe to say that 15 to 20 per cent of the lands reclaimed by irrigation have been ruined or are endangered by seepage or alkali. Assuming that a total of 20,000,000 acres of land have been irrigated within the United States, then from 3,000,000 to 4,000,000 acres have been affected and possibly a million acres have been rendered useless. If the cost of irrigation and other improvements is taken at $100 per acre, then the net loss is about $100,000,000. Much of this loss could have been prevented, if engineering skill and forethought had been employed.

Sufficient studies and investigations have been made and sufficient works constructed to show the feasibility of protecting reclaimed lands from a waterlogged and alkaline condition. The U. S. Reclamation Service is understood to have expended already upwards of $10,000,000 in providing drainage works, and continued investment must be made as conditions develop.

Extensive studies of this problem in the Imperial Valley in southern California, have resulted in a drainage program involving the expenditure of $2,500,000. Excellent results have been obtained already in some parts of the valley, but in some other portions of the valley where exceedingly tight soils exist considerable time will be required to restore the lands to their former condition and value. In the Palo Verde Valley, between Needles and Yuma, on the Colorado River, it has been demonstrated that drainage will be effective, and construction work is soon to be commenced.

Drainage is as necessary to the ordinary irrigated area as is a sewerage system to a community when an abundant water supply has been brought to the houses. Many localities are becoming alarmed at the rise of ground water. This rise is due largely to the fact that the irrigation water supply is so great that there has been little enforced economy in its use. On many of the irrigation enterprises there has not been a continuous observation of the ground-water conditions or a systematic study of the subsoil relations. As an example of these conditions, vineyards worth $1,000 an acre in the San Joaquin Valley, California, gradually went out of bearing. The vines were pulled up and alfalfa was planted, but in a few years the alfalfa also ran out and barley was tried. Later, the land was given over to salt grass. This great loss could have been avoided by proper diagnosis and treatment before the conditions appeared on the surface.

Taking care of irrigated lands, especially in large areas provided with an abundant water supply, involves the following considerations: (1) The determination of ground water and alkali conditions of the soil; (2) the working out of measures which will control the ground water and protect soils from becoming unfit for cultivation. Detailed studies along these lines are frequently of little interest to the engineer trained primarily in planning and building works for irrigation. The curative measures involve the planning and construction of drainage works and the maintenance of these works in such condition that they will perform their functions. Even with adequate drainage works, questions involving irrigation and the methods of handling soils in order to keep them in proper physical condition must be given attention.

Beyond the laying out and construction of drainage works, constant vigilance is necessary to see that the works are properly performing their function and that new conditions or complications detrimental to the soils do not arise or are remedied. These problems may be classed as "engineering questions," but many of them do not come within the scope of ordinary engineering practice. They can be solved when engineers and others who have to do with irrigation are taught to realize that all irrigation enterprises are threatened by the dangers of excess water and alkali.

Submarine Rock Drilling Records and Unit Costs

Open "Lake and Inside" Harbor Drilling Alternated as Weather Determined—Range System Prevented Duplicate Work

By Emile Low
Buffalo, N. Y.

DRILL boat operations in Buffalo harbor and in the lake outside the harbor entrance make possible a useful analysis of submarine drilling records and costs. The rock drilled consisted of hard limestone, which underlies the vicinity of Buffalo, and the adjacent north Canadian shore of Lake Erie. The holes ranged from 4.2 ft to 8.6 ft. deep. It was necessary to drill to a minimum of 26 ft. below mean lake level, in order to make sure that no material was left above the depth of 23 ft. This necessitated drilling 3 ft. below grade. The spacing of the holes was 4 ft. between the rows and also 4 ft. between holes. Generally 30 holes were drilled at one setting of the drill boat, each hole being shot as soon as finished.

TABLE I—OUTPUT TOTALS OF DRILL BOAT

Section	Hours Worked	Hours Delayed	Total Hours	No. of Holes Drilled	Average Depth	Total Lineal Feet Drilled	Area Drilled Square Feet	Cubic Yards Drilled to Grade	Cubic Yards per Hole	Dynamite Used Pounds
1	1,366	59	1,425	5,567	5.6	30,640	85,582	8,093	1.5	16,155
2	1,358	121	1,479	6,470	5.7	36,889	103,162	10,335	1.8	20,143
3	1,153	49	1,202	3,790	7.9	30,086	68,448	12,243	3.2	23,355
Total	3,877	229	4,106	15,827	6.2	97,615	257,192	30,671	1.9	59,653

The boat was steel and had a length over all of 137.5 ft., a beam of 32 ft., and a depth of 6.5 ft. It was anchored in position for drilling by four spuds, one at each corner. It carried five steam drills, each mounted on a structural steel frame, the drills being raised and lowered by cables operated by small hoisting engines, instead of by a hydraulic cylinder. With this exception the other equipment, spud and other hoisting machinery, boilers, etc., did not vary much from the usual drill boat outfit. Loading the holes and firing the charges were done in the customary manner.

Tables I and II give the performance and time records. The explosive used was Atlas 60 per cent nitroglycerine in 2 x 8 in. cartridges. The boat was operated day and night, in two 11-hour shifts, the crews changing at 6 o'clock a.m. and at 6 o'clock p.m. Each crew and their wages were as follows:

1 Foreman—$6.00 per day	$6.00
5 Drillers—$3.31½ per shift of 11 hours	16.57
1 Blaster—$3.59 per shift of 11 hours	3.59
6 Deckhands—$2.71 per shift of 11 hours	16.26
1 Fireman—$3.04 per shift of 11 hours	3.04
1 Blacksmith—$3.59 per shift of 11 hours	3.59
2 Blacksmith helpers—$2.49 per shift of 11 hours	4.98
Overtime, estimated	.97
Per shift	$55.00
Per hour	5.00

The men lived ashore and boarded themselves, being carried to and from their work by the construction company's tugs.

In addition to the wages there were other fixed expenses per shift, which are tabulated below:

Coal—4 tons @ $3.00	$12.00
Oil and waste	2.00
Small repairs and incidentals	8.00
Total	$22.00

TABLE II—UNIT PERFORMANCES OF DRILL BOAT

Section	Days Worked	Holes Drilled per Day	Feet Drilled per Day	Holes Drilled per Hour	Feet Drilled per Hour	Feet Drilled per Drill Hour	Area Drilled per hour	Cubic Yards Drilled per Hour	Dynamite, Lbs. Per Cu Yd.	Dynamite, Lbs. Per Lin. Ft. Hole	Dynamite, Lbs. Per Hole
1	65	85	471	3.9	21.5	4.3	60.1	5.7	2.0	0.61	2.4
2	67	96	551	4.4	25.0	5.0	69.8	7.0	1.9	0.54	2.1
3	55	69	547	3.1	25.0	5.0	56.9	10.0	1.9	0.77	6.2
Total	187	85	522	3.8	23.8	4.8	62.6	7.5	1.9	0.61	3.8

The total expense of operation was then $77, or $7 per hour.

Table III shows approximately the cost of operating the drill boat during the time of its employment. The capital cost was as follows:

Cost of drill boat	$50,000
Interest, 6% for 1 year	$3,000
Depreciation, 10% for 1 year	5,000
Total	$8,000

The boat was actually engaged in work 7½ months, but to allow for fitting out and laying up, 8 months time has been allowed. It will be noted that the time lost was only a little over 5 per cent of the total possible working time.

The largest item of expense is labor, 36 per cent; fuel, oil, waste and repairs are 14 per cent; while towing, explosives and interest and depreciation are each 13 per cent. The items of superintendence, yard and office expenses make up the remaining 11 per cent. To the above cost must be added that of dredging which will average 20c. per cubic yard for drilled and blasted rock, scow measure, which is equivalent to 40c. place measure.

TABLE III—DRILL BOAT OPERATING COSTS

			Per Hole	Per lin. ft.	Per cu. yd.
Labor, 200 days, @	$110.00 =	$22,000	$1.39	$0.23	$0.72
Fuel, oil, waste, repairs, etc., 200 days @	44.00 =	8,800	.56	.09	.29
Tug, towing, 200 days @	40.00 =	8,000	.50	.08	.26
Explosives, 60,000 lb. @	.12 =	7,200	.45	.07	.23
Exploders, 20,000 @	.04	800	.05	.01	.03
Superintendence, etc.		2,000	.13	.02	.06
Yard expenses		3,000	.19	.03	.10
Office expenses		2,000	.13	.02	.06
Interest and depreciation		8,000	.50	.08	.26
Totals		$61,800	$3.90	$0.63	$2.01

Where submarine bedrock excavation is carried on in exposed situations, and operations are intermittent, the cost can easily reach double that figured above.

The contractor was the Empire Engineering Corporation, New York, N. Y.

Accidents to Water Department Employees

Out of a payroll of nearly $2,000,000 at the Detroit Water Department for the year ending June 1, 1922, there were 248 accidents to employees of which 205 were non-compensable. Of the forty-three compensable cases the department paid $2,459 compensation and $1,374 hospital charges. Fees for medical attention and services for the 248 cases were $2,515. Fourteen first-aid cases were cared for by foremen and time keepers. Of ninety-one automobile accidents with department cars thirteen cases were held to be the drivers' fault and nine unavoidable. In forty-five accidents outside parties were held responsible but no damage was done the department cars. In twenty-four accidents outside parties were billed for $341.34.

Publicity Only Will Not Raise Engineers' Status

Potentialities of Engineer for Public Leadership as a Citizen Must Be Developed—Operations in Iowa

Abstract of report of publicity committee to the Iowa Engineering Society, by W. J. Schlick, Chairman.

MOST discussions of publicity for engineers are based on three related principles: (1) Engineers do not have the standing, and do not receive the recognition to which they are entitled. (2) This condition is due to a lack of appreciation, resulting from a lack of understanding on the part of the general public. (3) Publicity will correct this error on the part of the public. Publicity is considered as a sort of magic automatic elevator; the engineer gets on by writing something of his work, or by declaring his belief in the above principles, and presto! he becomes recognized as "the" man of value in his community. The committee on publicity of the Iowa Engineering Society has taken a slightly different view. It believes that publicity—news stories and feature articles telling of the engineer's work and setting forth its value and importance to the community—is desirable. But it believes that more will be required before the profession reaches the place engineers wish it to have.

It is hard to believe that the world is in a conspiracy to hold the profession back, or that the engineer does not have the place in public life to which his work and service entitle him. In the long run most of us get just what we deserve, whether we are engineers, lawyers, doctors, merchants or bootleggers. If this be true it remains for us to find the trouble and the remedy in ourselves.

We frequently enjoy having one of our number, or better yet a prominent man from another state, tell us how much better public affairs would be conducted if only engineers were in charge of those affairs. Such discussions always imply that the engineers have all the necessary requirements but that some intangible something prevents them from attaining those positions. Has your work or mine, that of the average member of this society, ever been such as would lead anyone to guess that we had those qualities? Your committee believes that, potentially, the engineer has the qualifications necessary to a successful handling of public affairs, but that some of the very necessary of those qualifications are, at this time, only potential. These qualifications exist but they have not been developed nor used. Too many of us are "kidding" ourselves into believing that a desire to hold positions requiring those qualities is equivalent to a certain knowledge that we do possess them. Until engineers choose to develop and use those qualities, this talk of the value of the engineer in charge of public affairs is going to continue to be largely talk.

The question of whether the engineer wishes to step out of the strictly technical field into this broader field seems to be answered, so far as this organization is concerned, by the frequent discussions of these subjects, and your committee felt free to consider it because it is unfair to expect a little publicity work to furnish all the power to operate the elevator to fame and recognition.

What is the outstanding difference, so far as this consideration is concerned, between the doctor, merchant or attorney who gets behind some project of public improvement, and the average engineer? Simply this. The doctor or attorney considers the improvement from a general standpoint as a citizen, while the engineer considers it from the standpoints of materials, stresses and economics. The successful promoter considers the problem in terms and from a viewpoint which the general public can understand; the engineer's terms and viewpoint are so almost wholly "Greek" to the public that they hardly know whether he has considered it at all. So long as the engineer confines his efforts wholly to his technical work as an engineer, the public cannot know much about him.

The engineer cannot educate the public to his viewpoint, at the start at least, so if he wishes to put the elevator into operation he must adopt the viewpoint of a citizen and work as a citizen of his community. If he renders this sort of service along with his technical service, the public can and will recognize his value and importance. Publicity is necessary, but it is only one part. When the engineer thinks and talks as engineer-citizen he will recognize more "news stories" in his work, and will do more work that is of itself news. If he continues this development he will soon reach a stage where he will "receive" publicity—he won't have to "get" it.

All of us hear statements that "the society or the profession ought to do so and so." What idea is back of such a statement? Too often it is an idea that the society or the profession is an abstract something, the speaker having no direct connection with the doing of those things though he may come in for a part of the benefit. When each engineer will speak and think of his society and his profession as "we" instead of "they," and realize that he is speaking and thinking of a group of individuals and not an abstract "it" or "they," advancement of the profession through society efforts will be certain. Upon these principles the committee has based its work. It has concluded that legitimate publicity for the engineer's work is necessary and that before the engineer can change his status greatly he must think and act as a citizen as well as an engineer.

As we see it, it is up to the engineering profession. If the members are willing to pay the price in work they can attain any status or place they choose, but we cannot get something for nothing from the profession any more than we can from the Iowa Engineering Society or the corner grocery.

After a consideration of the needs and possibilities the committee decided on a short intensive program. (1) Letters to each member of the society asked him to prepare, and offer to his local paper, a description of the interesting features of his season's work; this letter to be followed in two weeks by a follow-up letter to jog his memory if he had laid the first aside and forgotten it. (2) Some engineers in each county were requested to take the responsibility of seeing that a tax-analysis diagram for his county be prepared and copies placed in the treasurer's office and the bank at tax-paying time. Each man was left free to organize the plan of procedure as he saw fit, except that we suggested that the work be done through and credited to local clubs where such clubs were formed.

It was realized that some members would not be in a position to prepare and publish articles because of their connection with organizations having a designated publicity officer, or because of their employment as subordinates, but we felt that all should know what we were trying to do. A number of letters were received explaining why the writers could not do as we suggested. Some replies indicated confusion in the minds of the writers as to the difference between news stories and the longer descriptive feature articles. There was some tendency to criticize the papers for refusing to print write-ups of the latter class as regular news items. Irrespective of what we may think of the relative importance of what is printed and what is submitted, we must realize that if we are going to play the newspaper man's game we must play it his way, at first at least, because he hasn't asked us to come over into his yard to play.

In only one case did the submitted articles show any tendency to attempt to use the write-up as a means of personal advertising. Many of the articles were really good boosts for the engineer in question but he was mentioned only in the manner necessary to describe the work.

Twenty engineers sent in clippings or reported that articles had been published or accepted for publication, an average of one out of each twenty-five members.

Our batting average in the tax-analysis work has been more gratifying. Replies have been received from the men in 38 counties, all but three expressing approval of the plan and promising to prepare and place the diagrams.

Lower Mississippi River Problems Discussed at New Orleans

Papers Describe the Methods of Flood and Navigation Control and Discuss Necessity for Change in Accepted Methods

FOLLOWING the recently inaugurated policy of concentrating the technical features of the quarterly meetings on some one phase of engineering, the spring meeting of the American Society of Civil Engineers at New Orleans, April 18-20, was devoted to "The River and Harbor Problems of the Lower Mississippi." Two technical sessions were held at which eleven papers were presented. Unfortunately the time allotted was too short to permit full discussion so that the proceedings consisted mainly in the presentation in abstract of papers available in preprint form.

The papers fell roughly into two classes; those descriptive of the navigation control and operation on the lower river and those concerned with the matter of flood control. The former, being plain statements of fact, admitted of but little difference of opinion; the latter, on the contrary, were of a highly controversial nature and promised considerable discussion, which as it turned out, will have to be held over for the "Proceedings" of the society.

History of River—Maj. Gen. L. H. Beach, Chief of Engineers, U. S. A., opened the descriptive papers by an exposition of the "Work of the Corps of Engineers on the Lower Mississippi." He said that the Mississippi was not to be compared with the European rivers on which most of the science of river hydraulics is based. It is much larger, has prolonged rainfalls in its drainage where those in Europe are fed slowly from melting snow, is silt bearing to a high degree and of great variability in volume. All of these facts make the rules laid down abroad of limited value here. General Beach recited the history of the control of the river, the slow elevation and prolongation of the levees, the two pass developments at the mouth and the steady improvement of the banks and levees against caving. He said that the river needs continued study and more money. When the flood crises come all the engineers can do is to watch the critical places and fight the floods by the accepted methods. He referred to the work at the Passes as the most difficult task in engineering in the world today, the one place where sufficient money is of little importance. General Beach did not refer specifically to any method of flood control or to the proposed spillway at New Orleans.

Sydney F. Lewis, of the Louisiana State Engineer's office, said in discussion that it was imperative for control of the lower river that there be a complete levee system, and that the bank protection be carried forward. There is more danger from caving than from overtopping.

Success of Levees—A. L. Dabney, consulting engineer of Memphis, Tenn., presented in abstract a paper entitled "Success of the Levees During the Flood of 1922." In general he said the system was proved successful last year for in the 1,000 miles between Cairo and New Orleans, with 1,400 miles of levees only partly up to commission standard, there was only one break and that in a levee 24 ft. below standard. There were two breaks below New Orleans, also in non-standard sections. He admitted that there would have been more breaks had it not been for determined fights at numerous points but such fights are a part of the system of levee control. He cited the following tabulation of levee breaks in recent floods:

Year	No. of Crevasses	Area Flooded
1882	700	100 per cent
1912	15	30
1913	7	10
1916	1	5
1922	1	1

As a result he concluded that any engineering project which functions 99 per cent, as did the levee system in 1922, is a success, particularly when progress has been made as indicated in the table. Mr. Dabney further presented his prediction as to prospective flood heights based on the best present knowledge, as follows: Cairo, 57; Memphis, 47; Helena, 57; Baton Rouge, 48.5; New Orleans, 24. He believed levee heights 4 ft. above these gages would insure safety against greatest possible flood.

Spillways—John Klorer, city engineer of New Orleans, in a paper entitled "The Flood Problem of the Lower Mississippi River," gave the view of those who are not entirely satisfied with the "levees only" theory of control and who feel that spillways below New Orleans would tend to relieve that city from danger in extreme floods. He referred to the report of the "Safe River Committee of One Hundred" described in *Engineering News-Record*, Jan. 4, 1923, p. 21, and its recommendation for a spillway near the site of the Poydras crevasse, ten miles below New Orleans on the east bank of the river. Of the "levees only" theory and the safety of the proposed spillway, he said:

> The policy of closing off basins or parts of basins in the upper districts regardless of providing facilities in the lower river for safely passing the extra amount of water thus sent to it seems to have met with little opposition until recently. The attitude of complacency heretofore existing in this part of the state to such procedure may be attributed to accepting unquestionably certain doctrines preached by the Mississippi River Commission most prominent among which was the following: "An alluvial stream flowing in a bed of its own formation will ultimately scour out a channel to accommodate its flow." The high authority pronouncing this dictum was responsible for the hope that was aroused in the minds of the people of the valley that an application of the confinement theory would in due time enlarge the section of the river and eventually take care of the floods at lesser heights. Twenty-five years application of this theory on the lower river under the most favorable circumstances have showed no indication of the fulfillment of this doctrine. The very opposite conclusion is inescapable to anyone who will compare recent discharge measurements with those of former years. The people of the lower valley hailed with delight the announcement in 1914 of an ultimate levee grade based on an ultimate high water, believing that the upward revision of levee grades had at last come to an end. But they have since viewed with distrust the gradual degradation of the term "ultimate grade" into the term "approximate ultimate grade" and now the more recent term "present provisional levee grade."
>
> The advocates of the Lake Borgne Spillway did not contemplate that it would be possible to maintain the bed of the spillway channel without erosion. It was recognized that erosion would follow and as an attempt at directing the location of the erosion it was believed that in building the side levees, these should not be built from excavations taken near the berm, but should be built by hydraulic

dredge, digging a pit along the axis of the proposed channel to induce as much as possible the scour to take place midway between the side levees. Manifestly it would be desirable to permit the discharge from the spillway to dig a channel for itself and depress its bed or entrench itself for the entire five miles from the lake to the weir. By bringing gulf level from Lake Borgne to the flexible concrete mattress apron provided at the rear of the weir, the problem of maintenance could be localized and better handled.

As to the danger of the structure washing out on account of the character of the foundation and insufficient dimensions, this is a question open to discussion after examination of a suggested plan that was prepared for the consideration of the government authorities. It was recognized from the start that the plan as submitted and as finally decided on might involve considerable modifications. For instance no study was given to the hydraulic jump feature as a means of dissipating some of the energy of flow. The shape of the rear surface of the weir should be dependent on the outcome of observed results on experimental models constructed to scale. The question as to the proper width of the flexible concrete mattress beyond the rock cribs while shown as being 200 ft. wide was also recognized as being a detail open to further discussion. A combination of the rigid type of structure typical of American practice, and of the flexible type of structure, as practiced in Egypt and India, was chosen, since both types seem to have desirable features.

With reference to the boldness of the undertaking to relieve the Mississippi River of 250,000 sec.-ft. over a weir 6,600 ft. long, constructed on a clay foundation, the job does not rate in magnitude with similar structures successfully executed by English engineers in India, notably the Dehri Weir (on the Sone River) which is 12,500 ft. long, and constructed on a sand foundation, and with a discharge capacity of 830,000 second-feet.

The flood of 1922 will be memorable in this end of the valley for many years, not by reason of the record-breaking elevations attained by the river that year, for these will be exceeded before many more years, but by reason of the sweeping aside of many of the traditions, theories, and folklore ideas concerning the flood control of the Mississippi River.

No longer will the people of the lower Mississippi valley believe the doctrine that you can put more water into the river and not raise the flood elevation appreciably. No longer will they believe that if you take water out of the river, it will not lower the flood height appreciably. Fine spun theories about the peculiar behavior of sedimentary streams under the conditions mentioned will no longer convince them to the contrary. The fallacy of these teachings was completely proven in 1922; closing Cypress Creek gap disproved the one, and Poydras crevasse disproved the other. As a result, there has been a slow sloughing away of the confidence previously felt in the "levees only" theory and an insistent demand for some additional form of flood control—a form of flood control that spells lower flood heights, not higher flood heights—a form of flood control that provides not only for flood protection—but for flood relief as well, and the proposed spillway into Lake Borgne will partly afford the desired relief.

Col. C. McD. Townsend (retired), Corps of Engineers, U. S. A., and formerly president of the Mississippi River Commission, had prepared a written discussion of the flood-control problem and the proposed spillway, which he presented only in brief abstract. He said that the demand for a spillway was only a repetition of post-flood activity for the past 75 years. In 1852, according to Humphrey and Abbott, the same arguments as today were given only to be refuted. Colonel Townsend said that spillways are impracticable mainly because of the difficulty of disposing of the water through them and not because of any impediment to navigation due to shoaling of downstream channel. If a spillway was to be built below New Orleans there are, he said, better sites than that through to Lake Borgne. Further, Colonel Townsend believed that he had absolute proof that the river was deepening its channel and, as a result, the levee system would not have to be indefinitely raised. He admitted that it was obvious that spillways, outlets or crevasses would all cover flood heights: That is not now the debatable question. The problem is the practicability of building and holding spillways and their economic necessity, considering the status of the levee system existing.

A final paper involving the question of flood control, though only indirectly, was the plea for a government experimental hydraulic laboratory by past-president John R. Freeman. Mr. Freeman's paper was in print, an elaborate discussion of the present state of knowledge of river hydraulics, a description of the few experimental laboratories of the kind sought, and the suggested design for the one prepared in Senator Ransdell's bill of the last Congress. In brief, Mr. Freeman's argument is that while there is no certainty that the Mississippi flood problem will be solved in the miniature channel which can be set up in a laboratory, there is a chance worth taking that investigations possible in such a laboratory will contribute much to our knowledge and practical applications may result. In conclusion Mr. Freeman took exception to the dictum of Mississippi River engineers that the river must not be straightened but must be led around the many bends it has established. He said this is a theory based mainly on navigation requirements and while he did not insist on the straightening theory as the solution of flood troubles, he did contend that there might possibly be more in it than its opponents admit and that it was worthy of more serious consideration than they are willing to give it.

Lieut. Col. E. J. Dent, Corps of Engineers, U. S. A., the district officer at New Orleans, took exception to Mr. Freeman's theory that the behavior of so tremendous a river as the Mississippi could be predicted from a miniature stream.

Papers on the port and navigation problem consisted of a general description of the port of New Orleans by John F. Coleman, consulting engineer to the Board of Port Commissioners at New Orleans, and of the whole question of lower river ports by S. M. Young, chief engineer of the same body. Both engineers pointed out the difficulties of construction on the alluvial silt and of freight handling design for a varying stage of twenty or more feet. The final papers were in advocacy of increased river transportation.

Additions to Wood Block Specifications

Two new sections were added to the specifications for wood block street paving and flooring which for some time have been before the American Wood Preservers Association. The specifications were adopted as standard. Bituminous mastic cushion consisting of 10 per cent of bitumen, either coal tar or asphaltic oil, and 90 per cent of clean, dry, screened sand may be used instead of a cement-mortar cushion. To permit the mastic to cure it is to be spread a day in advance of laying the blocks. A maintenance clause calls for inspection each summer and a surface treatment of light tar (¼ to ½ gal.) and sand when the pavement shows signs of shrinkage or open joints.

From Job and Office

Hints That Cut Cost and Time For the Contractor and the Engineer

Five-Story Chicago Warehouse Moved in Two Directions

HAULING a 4,000-ton building by cables instead of pushing with jacks was the method adopted in moving the five-story warehouse owned by B. A. Eckart and occupied by the Continental Paper Bag Co. on North Ada St., Chicago, when its original site was acquired for the extension of Ogden Ave. It was necessary to move the building 110 ft. south and then 220 ft. west to its new location, where foundations had been built in readiness. Cable haulage was adopted because of the greater speed possible over jacking, which latter

FIG. 1—MOVING A LARGE WAREHOUSE IN CHICAGO

The building has been moved south and is ready for changing the supports to move west to the rear of the two-story structure at the left.

is very generally used in moving buildings of this type. Hauling in this case averaged a distance of 64 ft. per day, with a range of 45 to 90 ft. The work in progress is shown in Fig. 1.

This building, erected in 1908, is 70 x 125 ft. in plan, with brick walls and heavy timber framing, the columns carrying beams on which are laid laminated wood floors and a wood roof. The bays are mainly 15½ x 16 ft., but with side bays 15½ x 18 ft. The floors are 2 x 6-in. sticks placed solid and on edge, with maple flooring nailed over them. As this flooring rests on brick pilasters and is not anchored into the walls, as where joists are used, the precaution was taken to tie the longer walls together at the fourth and fifth floor levels by means of four heavy tie rods with nuts bearing on pieces of steel channels placed horizontally against the outside of the walls. In the first story, four inclined shores were placed at each column and wedged up against the cap, as shown in Fig. 3, in order to distribute the load over the blocking built up under the first floor. Doorways and elevator openings were shored up with posts and jacks. Except for this shoring and the tie rods no reinforcement was made to the building in preparation for the move. There was no manufacturing machinery in the building. One of the long walls was a party wall. The loads per square foot were estimated at 3,740 lb. under the brick tower carrying the water tank, 3,715 lb. under the party wall, 3,400 lb. under the other walls and 2,420 lb. for the column footings.

Adjacent buildings had been torn down and as these were small unimportant structures there were no base-

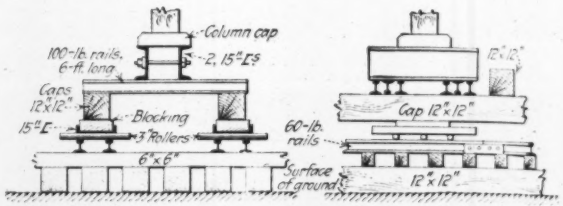


FIG. 2—ROLLING SUPPORTS FOR BUILDING

ments to be crossed after the warehouse had moved clear of its own basement. The line of travel crossed an alley but no streets. After the ground had been leveled it was practically floored with timbers 12 x 12-in. laid longitudinally in the direction of movement. Across these were laid timbers 6 x 6 in. supporting sixteen pairs of 60-lb. rails, the rails of each pair being 12 in. apart and carrying the 3-in. steel rollers on which the building moved. The arrangement of timbers, rails, saddles and rollers is shown in Fig. 2. Blocking between the upper timbers was placed under the rails, which were leveled up by wood shims as directed by an instrument man with level. At first the rails were not connected, but afterwards it was found desirable to use ordinary splice bars and bolts. Without the splicing the leaving end of one rail would droop under the load, so that the entering end of the next rail formed an obstruction to the rollers. With the spliced joints the rails deflected uniformly.

Raising the building about 3 ft. from its foundations was the first step and this was done with about 1,200 ordinary house-moving screw jacks. Most of these were of cast iron, rated at 5 tons load each, but there were also cast-steel jacks rated at 15 tons. Timber blocking was then built up in the basement to support the cap timbers and rails.

Traveling Supports—Under each of the end walls transverse to the line of movement were placed two lines of 12-in. I-beams across which were laid needles or short pieces of similar beams on which were timbers and wedges driven tight against the bottom of the wall. Across the building and parallel with the line of movement were I-beams extending the full width, and between their webs were wedged heavy

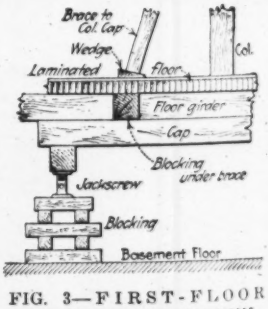


FIG. 3—FIRST-FLOOR BLOCKING AND COLUMN BRACING

timbers so as to form a rectangular framing. In addition to the continuous lines of I-beams there were four massive timbers 20 x 20 in. extending across the full width of the building so that there was no separate strain on the walls during travel.

Each basement column cap rested on a pair of 15-in. channels spaced about 16 in. apart and held together by long bolts. As the building was raised the basement columns dropped out. The channels in turn rested on two pairs of short rails laid across the cap timbers. Beneath the cap timbers were the lines of 60-lb. rails, with rollers and saddles fitted between the rails and cap timbers, as shown in Fig. 2.

These saddles were placed opposite each column and each wall pilaster. Each saddle consisted of a 15-in. channel 3 ft. 6 in. long with its flanges upward and the web carrying blocking wedged against the cap timbers. This channel rested on three 3-in. steel rollers laid across the pairs of 60-lb. rails already mentioned. Each saddle was estimated to carry about 17 tons, or nearly six tons per roller.

Haulage System—At ten points in the 125-ft. length there were attachments for the hauling system. At each of these points a pulley was shackled to a cable extending to the far side of the building and wrapped around a timber laid across the ends of the 12-in. I-beams. In this way the hauling strain was taken in compression instead of tension on the framing which supported the building. Three capstans were anchored about 275 ft. from the building, each having a ⅞-in. cable and operated by a team hitched to a sweep. The cable layout is shown in Fig. 4. The main cable was continuous between the two end capstans, being passed through the blocks already mentioned and a line of blocks anchored to deadmen in front of the building. In order to equalize the strain, however, a pulley was placed in the middle bight or loop and was attached to another block in the bight of a short cable from the middle capstan.

The three teams were started and stopped simultaneously by whistle signals to the drivers. When the central traveling pulley came up to the capstan, work had to be stopped while it was moved back to take up the cable slack.

Moving 110 ft. south occupied two days. Then

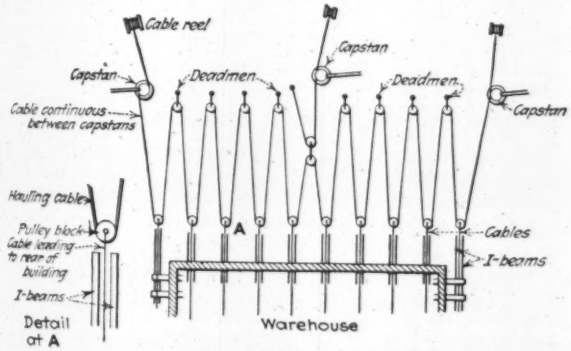


FIG. 4—LAYOUT OF HAULAGE CABLES

the entire framing system had to be changed to put the continuous lines of beams in the direction of the new movement westward. This next move of 220 ft. was accomplished in three days.

The final operation was underpinning the structure on its new foundations. By means of jacks it was lowered to the desired elevation, and brickwork was then built up tightly between the beams to fill the space between the foundation walls and the building walls. After the mortar had set, the timbers and needles were removed and the openings were bricked up. Concrete caps were built up on the concrete piers under the interior columns, 2 in. below cast-iron base plates, and this space was grouted through holes in the plates.

This moving work was carried out by the L. P. Friestedt Co., Chicago, under the personal direction of Frank P. Noe, president. The architects for the building were Zimmerman, Saxe & Zimmerman, Chicago.

Homemade Road Shoulder Shaper

By E. B. Blough
Superintendent of Construction
Illinois Division of Highways, Dwight, Ill.

After having tried for several years to accomplish fine shoulder grading on improved highways with a road grader, the writer became convinced that due to the fact the grader's wheels had to travel on the graded

IMPROVISED FINISHER IN OPERATION

shoulder extremely fine work was impossible. The machine herewith illustrated was devised.

Details of the sort of machine wanted were worked out first and taken to a local foundry and machine shop for an estimate. The estimate given of $200 was considered too excessive for an experiment so the chief mechanic and helper on the work made the finisher. They put in about three days making and assembling and trying out the machine. The total labor cost on it was about $35, and the material, besides the bolts, consisted of angles, I-beams and channels which were taken from the scrap pile collected from old bridges replaced. Reserve blades for a subgrader were used for the shoulder finisher blades. A few fish plates, bars, pins, hinges and old cable resurrected from the junk pile also were used.

The machine was tried out and worked even better than it was expected because it was found that in freshly graded dirt it quite easily cut 6 in. and disposed of it either on the ditch slope or in the ditch itself. As there was no lever for the adjustment of the blade, holes one inch apart were put in the bars the blade frame is attached to. Thus a finer adjustment was possible by removing two bolts on each side. The width of the shoulder cut can be regulated by sliding the I-beams to which the blade frame is attached out or in

as is needed, or by changing the line to which the truck is driven.

The finisher was attached to a trailer and pulled by a three-ton truck. A stick was fastened crosswise of the radiator and extended towards the center of the pavement far enough so that a chain could be hung from it to drag on the center crack in the pavement when the truck was in the right position to give the desired width of shoulder. With this arrangement a good truck driver was able to drive in almost perfect line, therefore getting a practically perfect shoulder.

It was found that if the shoulder was graded to within three or four inches of finished grade and left a few inches wide, a second trip with the finisher gave an almost perfect shoulder and slope, leaving but little hand work and that only at culverts, bridges and side roads. It was also found that in a few places the original grade was so heavy that a considerable amount of dirt was left in the ditches after the finisher went over. In most cases this could be smoothed off with a drag without disturbing the general line of the shoulder or the grade of the ditch.

Steel Stack Used as Mast for Derrick in Replacing Other Stacks

By George F. Paul
Chicago, Illinois

IN DISMANTLING and erecting three smokestacks at the Nassau branch of the Brooklyn Union Gas Co., considerable ingenuity was shown in using one of the stacks as a mast in forming a derrick by means of which the other stacks were handled. The stacks were 48 in. in diameter and 95 ft. high. They were of ¼-in. steel and weighed 13,680 lb. each. The roof over the stacks was slate resting on light angle iron strips and would just about stand the weight of a man, so it was impossible to work from this roof.

STEEL STACK USED AS DERRICK MAST

The workmen first removed some slate from over the building wall at the edge of the roof and then rigged up a 72-ft. pole weighing about two tons on this wall. Then they rigged up an 82-ft. pole alongside of the building, and dismantled and re-erected the end stack. Next they had this stack secured with an extra heavy back guy, then rigged the 72-ft. pole on this stack by lashing a steel wire around the stack and one around the base of the pole and securing a swivel in both lashings. The second stack was picked up and swung around to the 82-ft. pole and lowered to the ground. When the second stack had been re-erected the 72-ft. pole was then rigged on the center stack. The 82-ft. pole was standing in an alley which it was necessary to maintain unobstructed as coal was being taken through this passage-way at all times for the making of gas. This work was completed in 17½ days by the National Trucking & Rigging Co., Brooklyn, N. Y.

From Job and Office

Hints that Cut Cost and Time

Four Problems in Surveying

By L. F. Hammond
State Highway Department, Clintonville, Pa.

TO CHECK the offsets or lay-off a templet, strike-off, or subgrade tester on a circular curve at any point for any crown rise or pavement width use the following formula:

$$y = C\left[\frac{x}{d}\left(\frac{x}{d} - 2\right) + 1\right].$$

y = depth below crown at point "x", x = distance from outside edge of pavement, d = ½ width of pavement, C = crown rise.

To make a joint at right angles to a 16-ft. road, measure from a chalk mark on the inside edge of form 12 ft. along same, then diagonally 20 ft. to a point of intersection on the other form, which is directly opposite the first mark. For an 18-ft. road use distances of 24 ft. and 30 ft., respectively.

Where a railroad preliminary line has been superimposed on a map with given elevations the following method will give grades on curves for compensation.

Multiply the length of each curve by the degree of curve times the compensation factor; to the sum of the products add the difference in elevation between the first and last station and divide by the horizontal distance. This will give the grade in per cent for the tangents. Then for each curve deduct the degree of curve multiplied by the compensation and the result is the grade on the curve.

Example:

Length of section of a 5-mile line, Sta. 0 to Sta. 64 is 6,400 ft., difference in elevation 64 ft.; 10 tangents, total

From Job and Office

For Contractor and Engineer

2,750 ft.; four 12-deg. curves totalling 1,410 ft., four 8-deg. curves, total 930 ft.; and one 3-deg. curve of 740 ft.

14.10 x 12 x .035 = 5.922 (.035 = compensation factor).
9.30 x 8 x .035 = 2.604
5.70 x 6½ x .035 = 1.297
7.40 x 3 x .035 = .777

10.600
64.

64)74.600

Tangent 1.1656%

Compensated grade for

12 deg.	1.1656 —	(12 x .035)	=	.7456
8 "	1.1656 —	.28	=	.8856
6½ "	1.1656 —	.2275	=	.9381
3 "	1.1656 —	.105	=	1.0606

In tying in two surveys and desiring to reduce them to one set of co-ordinates, the differences "m" (long.) and "n" (lat.) and angle "a" of the azimuths are known. The corrected co-ordinate of any point "p" can be determined:

$x = (x' + y' \tan a) \cos a \pm m = x' \cos a + y' \sin a \pm m$

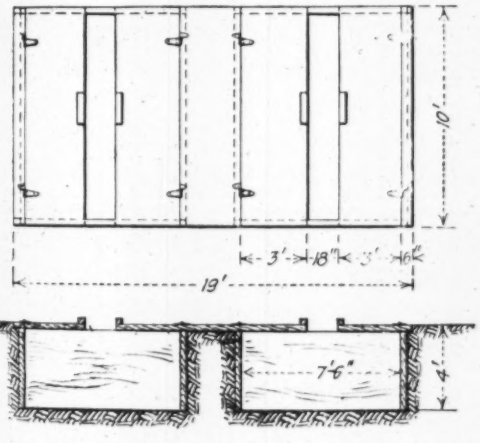
$y = (y' - x' \tan a) \cos a \pm n = y' \cos a - x' \sin a \pm n$

If "a" is under 10 ft., $x = x' + y' \tan a \pm m$; and $y = y' - x' \tan a \pm n$.

x and y are corrected co-ordinates, x' and y' co-ordinates to be changed.

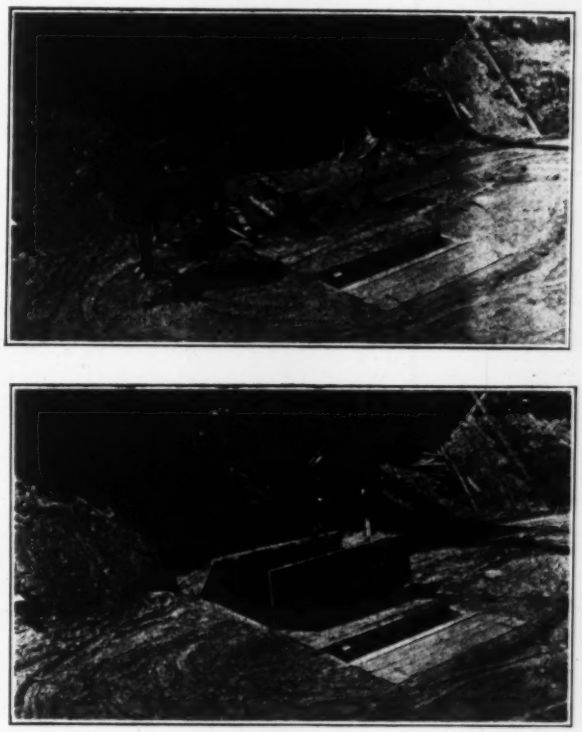
Fresnos Deliver Direct to Skips in Traps Under Hinged Covers

IN FINISHING the last of the excavation and trimming the slopes of the intake canal on the Pit River project in California, after the steam shovel has been taken out, it was necessary to lift a considerable yardage of earth from the bottom of the cut which is about 50 ft. deep. The quickest and cheapest means of getting this material to the top of the cut was by means of a skip operated with stiff-leg derrick on the edge of the cut. A suitable derrick was already on the job, having been used in the canal operation. The material could best be collected and delivered to within reach of the derrick boom by means of Fresno scrapers. It was therefore decided to devise some means of loading skips direct from the Fresnos.



PLAN AND ELEVATION OF TRAPS BUILT IN THE BOTTOM OF THE EXCAVATION

To accomplish this a pair of pits or traps were dug, lined with plank and covered by hinged plank doors, as shown in the accompanying illustration. With an empty skip in one of these traps and the covers closed, earth was dumped from the scrapers through the space between the covers into the skip beneath, this dumping process being continued until the skip was loaded. A laborer stationed there for the purpose would then shovel into the skip any material left on the cover and attach the skip chains to the hook lowered from the derrick.



DEVICE FOR LOADING SKIPS DIRECT FROM FRESNOS IN FINISHING DEEP OPEN CUT

Above: Fresno dumping into skip in trap through space between covers.
Below: Skip being lifted out of trap by derrick, raising the covers automatically as it rises.

In the process of lifting the loaded skip the doors would automatically be opened and would remain open ready for the return of the empty skip. In this way the final cleaning up of the cut was done quickly without the use of many men or much equipment. By using two skips and filling them alternately the teams could be kept busy continuously while alternate skips were being handled by the derrick.

The work was under the direction of O. W. Peterson, construction engineer for the Pacific Gas & Electric Co., from whom the foregoing information was obtained.

Computation of Areas Mechanically

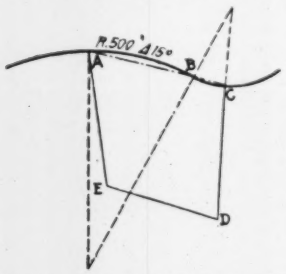
By Reeve Conover
Del Monte Properties Co., Pacific Grove, Calif.

THE following system is in use in this office for working traverses and areas in the curved subdivision of a tract of about 5,000 acres belonging to this company.

Traverses—Write courses and angular functions, and set the north and east co-ordinates of point "A" in cols. 5 and 6 as shown in tabulation.

(1) Cos.	(2) Stations & Bearings	(3) Sin	(4) Distance	(5) North Co-ordinates	(6) East Co-ordinates
.....	"A"			985.42	617.55
	N 10° 00′ E		165.14		
.98481		17365			
.....	"B"			1,148.05	646.23
	N 65° 00′ E		543.14		
.42262		.90631			
.....	"C"			1,377.59	1,138.48
	S 80° 00′ E		114.25		
.17365		.98481			
.....	"D"		.....	1,357.75	1,250.99

Set the north co-ordinate of "A" in the lower dial of the calculating machine with the decimal point seven places to the left (985.4200000), then set .98481 (cos. of 10°) on right hand side of keyboard. Turn operating crank ahead, as for multiplication, until 165.14 appears on upper dial. The lower dial then shows 1148.05 which is the north co-ordinate of point "B"; clear keyboard and upper dial only and proceed in a like manner to obtain the north co-ordinate of "C"; in figuring the third course the operating crank should be turned backward, as for division, as this course runs south and the operation is subtractive. Continue until all north co-ordinates are computed, then figure the east co-ordinates in the same manner, turning ahead for east and backward for west.



AREA CONTAINING CURVED BOUNDARY

This assumes that the origin of co-ordinates lies south and west of all parts of the area under consideration. This method eliminates the necessity of knowing the "latitudes" or "departures" as the co-ordinates are taken directly from the machine, which multiplies and adds (or subtracts) simultaneously.

Areas—To figure the area of the foregoing, having completed the closure, write the co-ordinates as follows:

	(a)	(b) North Co-ordinates	(c) North Differences	(d) East Co-ordinates	(e) East Differences
1	"A"	985.42	.....	617.55	.....
2	"B"	1,148.05	—392.17	646.23	+520.93
3	"C"	1,377.59	—209.70	1,138.48	+604.76
4	"D"	1,357.75	+613.76	1,250.99	—422.27
5	"E"	763.83	+372.33	716.21	—633.44
6	"A"	985.42	—384.22	617.55	—69.98
7	"B"	1,148.05	.....	646.23	.....

The values in Column (c) are differences between alternate north co-ordinate values, thus 1377.59 — 985.42 = 392.17; and Column (e) gives differences between alternate east co-ordinate values. The algebraic sum of each of Columns (c) and (e) is zero. Multiply Columns (c) and (d) together and check by multiplying Columns (b) and (e), leaving the resultant of the operations in the lower dial. Individual products do not need to be considered as the final result is their algebraic sum; in the above case, 305,028 sq.ft. This is twice the area of the figure and the acreage is obtained by dividing by 87,120.

Figures With Curved Boundaries—

In computing the area of the figure shown in the figure herewith write the co-ordinates of points A to E inclusive and compute, as shown above, the area $ABCDE$. Add to this the area of the segment lying along AB and subtract that of segment along BC.

The area of a segment $= R^2(\Delta - \sin \Delta)$, the angular value in the first term being in radians which is the value given in the tables usually called "arcs for radius 1". Thus the area of segment along AB is

$$250000 \frac{.26180 - .25882}{2} = 372.5 \text{ sq.ft.}$$

In this office we have computed and blueprinted a table giving the values of $\Delta - \sin \Delta$ for each minute of arc and to five decimal places. We also have a circular slide rule graduated for these values and for R, which gives double segment areas at one setting to a degree of precision sufficient in most cases.

From Job and Office

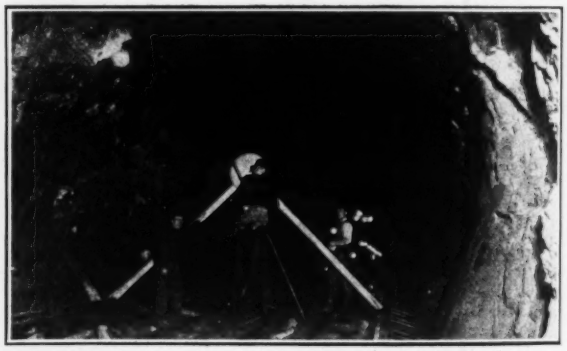
Hints that Cut Cost and Time

Inexpensive and Effective Tunnel-Gun

By Aaron Evans
Rockport, Wash.

AN EFFECTIVE tunnel-gun made on the job at little expense is being used in the construction of Seattle's 11,000-ft. pressure tunnel. Construction was as follows:

Jumbo tracks were laid to line and grade near the intersection of the side walls and the tunnel invert. These tracks are a constant distance from the tunnel center line. A cross-section device was built to fit across these rails. The protractor was set in the center of the tunnel. It automatically becomes perpendicular and at right-angles to the axis if the feet are set properly on the jumbo tracks. A plumb line is then hung from the center of the graduated disk down past the 180-deg. mark. Once set a wing nut holds it in place.


INEXPENSIVE TUNNEL-GUN BUILT ON JOB

No time is lost in setting up this arrangement. The recorder limits the speed. The chainman of the engineering party doing the tunnel work built it under the supervision of W. D. Patterson, transitman.

From Job and Office

For Contractor and Engineer

Distant Reading or Recording Extensometers

SUCCESSFUL distant-reading and recording extensometers have been developed by the Bureau of Standards, using the principle that the resistance of a carbon contact varies with pressure or with displacement. Past attempts to make use of this principle for similar purposes met several vital difficulties: the contact resistance is erratic and its calibration cannot be depended upon; hysteresis effects make the indications of the instrument different when going up and down; the readings obtained are not directly proportional to the action measured. All these difficulties have been investigated in detail within the last two years, and means have been found to eliminate all of them to such a high degree as to make the apparatus well adapted to a great variety of engineering measurements. For the purposes of the civil engineer the most interesting application is to extensometers. Strains, accelerations, vibrations, and pressures can be measured by similar instruments; the instrument can be made either indicating or recording. In tests of large structural members and in connection with certain dynamometer work the Bureau of Standards has found the new instruments to be substantially equal in accuracy to anything heretofore available, with the great advantage that the reading can be obtained at a distance and can be made autographically. Both indicating and recording instruments of this type have been used by the Bureau of Aeronautics of the Navy Department for measuring stresses in airplane members and in parts of dirigibles, and instruments of 8-in. gage length are being used to measure the web strains in the wide-web column tests now being carried out for the Delaware River Bridge Commission by the Bureau of Standards.

Strength of Boiler Steel Independent of Rate of Loading

Tests by H. J. French at the Bureau of Standards reported in Technologic Paper 219, just issued, showed that the tensile properties of firebox steel at normal temperature and also at temperatures up to and including the blue-heat range (565 deg. F.) are independent of the rate of loading. The tests were made at varying rates of stretch, up to 1.6 in. per minute. There was little noticeable change in either tensile strength, elastic limit or ductility even up to the highest temperature of testing, 865 deg. F., though the author records a slight increase in tensile strength with rate of loading at this temperature. Exceedingly slow loading, in which the applied load was increased 100 lb. at five-minute intervals while testing the proportional limit and somewhat beyond, with subsequent ruptures at normally slow testing machine speed, was also tried. In these tests the increase of stress was at the rate of about 10,000 lb. per square inch per hour. At moderate temperature, 350 deg. F., this slow loading gave somewhat increased strength and slightly reduced ductility, but at temperatures of 563 and 865 deg. F., the effects were the opposite.

Slide Rule Solution of the Cosine Formula

By John R. Jahn
Williams and Jahn, Consulting Engineers, Berkeley, Calif.

THE usual formula for finding the length of the third side of a triangle when two sides and the included angle are known is unwieldly and can be simplified for slide rule checking. This can also be used for finding the distance between points located by stadia sights where lengths of rays and bearings to points are read.

In the formula $c^2 = a^2 + b^2 - 2ab \cos C$, a and b represent sides of a triangle and C the included angle.

Then $$c^2 = ab\left(\frac{a}{b}+\frac{b}{a} - 2\cos C\right)$$

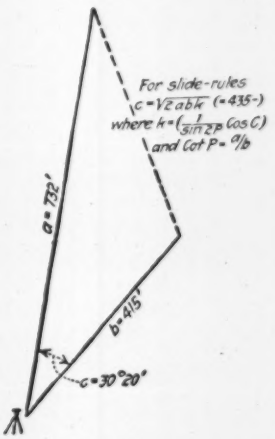
but $\frac{a}{b}+\frac{b}{a}=\frac{a}{b}\left(1+\frac{b^2}{a^2}\right)$ and if $\frac{a}{b}$ is represented by cot P

then $\frac{a}{b}+\frac{b}{a} = \cot P \sec^2 P = \frac{1}{\sin P \cos P} = \frac{2}{\sin 2P}$

and $$2K = 2\left(\frac{1}{\sin 2P} - \cos C\right)$$

and $$C = \sqrt{2a\,b\,k}$$

On the Manheim slide rule the A and B scales represent the squares of the D and C scales. Scales T and S are on the reverse side of the rule and are to be read opposite the index in the "window" of the reverse side. Perform $\frac{a}{b}$ where $a>b$ and read angle on T. Double this angle and set on S scale. Read $\frac{1}{\sin 2P}$ on the A scale opposite 1 on the B scale. Then set the S scale to read $(90° - C)$ (or cos C) and note value on the B scale under 1 at the right-hand side of the A scale. The difference between these two readings equals k. Then perform $2 \times a \times b \times k$ with the A and B scales, bearing in mind that the left half of either the A or B scales is for numbers 1-10 and 100-1,000 and the right half for numbers 10-100 and 1,000 to 10,000. The answer, or the length of the side "c," will be found on scale D opposite the above product.



STADIA PROBLEM SOLVED BY SIMPLIFIED METHOD

k may be written

$$\left[\frac{1}{\sin (180° - 2P)} + \cos (180° - C)\right]$$

for angles greater than 90°.

When $a/b > 10$ use the A and B scales instead of C and D and read angle on the S scale which is very nearly the same as cotangent for small angles.

In the example $a/b = 1.76 +$ and T reads 29° 33′ $(= P)$. $2P = 59°\ 06'$ and $\frac{1}{\sin 2P} = 1.165$. Cos C is found to be 0.854 and $k = 1.165 - 0.854 = 0.311$.

Then $C = \sqrt{2 \times 732 \times 415 \times 0.311} = 435 -$

The answer found by the long method is 434.85, which the slide rule result checks.

Letters to the Editor

This department aims to be a forum for the discussion of the views of engineers and contractors. The range of interest should be as wide as possible. Contributors are, therefore, asked to make their letters short.

Free Engineering Advice

Sir—I have before me a tract sent out by a manufacturing company to boost its product. It contains copies of the replies to letters which the mayor of a certain town wrote to numerous engineers and public officials throughout the country for advice as to the type of pavement advisable to use in paving one of the streets of his city. I have no fault to find with the product or the advertising of such products. What I do want to call attention to is the generosity of engineers in giving advice gratis.

The replies received were numerous and gave the opinions of the writers as to what was the best pavement to use. Some of the replies were qualified as suitable to certain conditions.

Now, how many replies would the mayor have received if he had sent out a circular letter to various attorneys throughout the country asking for their opinion on a legal matter? We think that the replies of all the attorneys would have been to "consult your local attorney." Only two of the more than fifty replies received from engineers advised consulting their local engineer or getting paid engineering advice.

After getting all this free engineering advice, the local authorities evidently considered that the advice was worth exactly what they paid for it—nothing, so they decided to call in another body of "experts," the abutting property owners, who decided the matter finally.

Various attempts have been made to have engineers live up to a certain code of ethics but with very little success. However, I am going to propose, not an addition to the code of ethics, but a simple motto—"If your advice is worth nothing, then don't give it. If it is worth something then don't give it—for nothing."

Pittsburgh, Pa., March 27, 1923. N. F. HOPKINS.

Protest Against Giving Name O'Shaughnessy to a Second Water-Works Dam

Sir—In *Engineering News-Record*, April 12, 1923, p. 685, it is stated that the Board of Supervisors of San Francisco on March 26 adopted a resolution providing that the Hetch Hetchy Dam shall hereafter be designated as "O'Shaughnessy Dam" in honor of its builder, M. M. O'Shaughnessy, city engineer of San Francisco. It is greatly to be regretted that the Board of Supervisors has chosen a name the exact duplicate of one already selected for another dam and adopted officially more than two years prior to the action taken by the San Francisco officials. I refer to the "O'Shaughnessy Dam" now under construction in connection with the enlargement of the water-works of Columbus, Ohio.

Following the death, early in 1921, of the late Jerry O'Shaughnessy, superintendent of water-works of Columbus (Mr. O'Shaughnessy served that city for nearly fifty years in the water-works department), the City Council, by a resolution unanimously adopted on Feb. 7, 1921, designated that the new storage dam to be built across the Scioto River should be named the "O'Shaughnessy Dam"; and in the *Engineering News-Record*, Feb. 24, 1921, p. 349, brief mention was made of the fact that the new dam would be named in honor of Jerry O'Shaughnessy.

It might be well to state that the "O'Shaughnessy Dam," and by that name I mean the new dam at Columbus, is a masonry structure of the overflow type, and will be about 70 ft. in height to the crest of the spillway. The dam will have a total length of about 1,500 ft., of which length about 1,000 ft. will be of masonry. A roadway will cross the dam, and over the spillway section it will be supported by twelve arches of reinforced concrete, each having a clear span of 64½ feet.

That the new dam at Columbus is known in the engineering press as the "O'Shaughnessy Dam" is evidenced by the following references to the *Engineering News-Record*, all but the first of which are in the Construction News Section:

March 23, 1922, p. 510. Brief note referring to the construction of the dam, and stating that bids would be opened on Apr. 20, 1922.

March 23, 1922, p. 128, bids for the dam desired.

April 27, 1922, p. 198, bids had been received.

May 4, 1922, p. 215, contract had been awarded to the Columbus Construction Co.

May 11, 1922, p. 232, new bids desired, first bids having been rejected.

May 18, 1922, p. 845, statement that the bidder to whom the contract was awarded had refused to sign the contract, and that new bids would be received.

May 18, 1922, p. 255, schedule of bids as received on Apr. 20, 1922.

June 1, 1922, p. 275, contract awarded to the Thompson-Starrett Co.

June 15, 1922, p. 307, schedule of bids (main items), as received on May 25, 1922.

In each of the items just mentioned the work is referred to as the O'Shaughnessy Dam.

The contract for the work is known officially as Contract No. 10, for "The O'Shaughnessy Dam and Appurtenant Works," and in the contract is included the mounting of two bronze tablets on the dam. One of these tablets will give the names of the officials connected with the work; the other will bear the following inscription:

O'SHAUGHNESSY DAM

BY RESOLUTION OF THE COUNCIL OF THE CITY OF COLUMBUS, ADOPTED FEBBUARY 7, 1921, THIS DAM WAS NAMED AND DESIGNATED THE "O'SHAUGHNESSY DAM" IN HONOR OF THE LATE JERRY O'SHAUGHNESSY WHO SO FAITHFULLY AND WELL SERVED THE CITY AS SUPERINTENDENT OF ITS WATER WORKS FOR MANY YEARS.

It is unfortunate that the San Francisco officials, in renaming the Hetch Hetchy Dam, should have chosen the name "O'Shaughnessy Dam"; but from what has been presented above, it would seem clear that the City of Columbus, officially, has first claim on the name "O'Shaughnessy Dam," and therefore it would appear appropriate for the Board of Supervisors of San Francisco to rescind their action and honor M. M. O'Shaughnessy in some other way.

Baltimore, Md., April 16. JOHN H. GREGORY,
Consulting Engineer, Bureau of
Water-Works Extension, Columbus, Ohio.

Expansion Joints and Cemented Beds for Granite Blocks

Sir—Cracks and subsidences in stone block pavements are common and are caused commonly and respectively by expansion and contraction and by the shifting of the sand bed on which the blocks are laid. To lessen these damages the writer in a recent new specification for granit block pavement on concrete base and with grouted joints, has stabilized the sand bed by adding cement and has called for transverse expansion joints. The two clauses are as follows:

CEMENT SAND BED: Not less than ten days after the concrete foundation has been completed, there shall be spread upon this foundation a bed of cement and concrete masonry sand, consisting of one part cement and four parts of concrete masonry sand of which the depth shall not be greater than 1 in. after rolling. The sand and cement must be thoroughly mixed dry before placing either by an approved type of mixer, or by hand on a mixing board or pan. The material shall be thoroughly mixed until a uniform color is obtained and should be spread on the foundation in this condition. The cement sand bed shall be struck off with a template and be brought to the exact form and section shown on plans to the required depth below the finished grade. After the bed has been leveled off it shall be rolled with a hand roller weighing about 300 lb. If any depressions develop they shall be filled in and the bed again leveled and the rolling shall be repeated as many times as are necessary to compress the sand bed. Tramping upon the cementbed is prohibited. The inspector shall keep the block culled and the contractor shall make the necessary changes and replacements so that the work at all times shall be ready for the grouting within 100 ft. of the pavers.

All the block laid must be rammed ready for grouting at the end of the working period and each day's work must be completed in full.

Before the grouting is applied the rammed block shall be thoroughly wet by sprinkling. It is important that the blocks be well wet so as to set up the cement-sand-bed. An excess of water over that required and taken up by the cement-sand cushion must not be used.

EXPANSION JOINTS: Expansion joints shall be placed along each curb and shall extend from the surface to the subgrade and shall be ½ in. in thickness. Any suitable pour-tarred joint or premolded joint expansion material satisfactory to the engineer may be used. A transverse joint ½ in. in width extending through from the surface to the sub-grade shall be made between each 50-ft. section or at such other spacing as may be directed by the City Engineer. The tarred felt transverse joint material will project above the finished pavement and when the pavement has obtained its hard set, the projection of tarred felt above the finished pavement will be struck off with a suitable cutting tool so as to leave a slight projection of the tarred felt above the finished surface of the pavement.

In general the proposed cement-sand bed is commended by those who have reviewed the new specification but few are ready to agree that expansion joints are needed. It is suggested that a wider expression of opinion than the author has been able to secure personally would be of value.

Watervliet, N. Y. WILLIAM J. HEALEY.
April 2, 1923.

Garbage and Refuse Disposal at Seattle

Sir—Absence from my office has kept me from sending to you earlier the following notes on garbage and refuse disposal in Seattle, which are supplementary to the article published in your issue of Nov. 23, 1922, p. 876:

In early days Seattle made use of what was called the sanitary fill and never entirely departed from that system. About 1888, there arose a great outcry against the making of these sanitary fills and the city built a boat with a hopper bottom and caused all refuse to be hauled down to the beach and deposited in this boat, which was towed a number of miles up the Sound and then discharged. At a little later date a second boat was built and there were disposal wharves in both the southern and northern parts of the city. About 1896 these boats were turned over to me for operation in connection with other duties as city engineer. At that time the collection was made by private parties who contracted with private citizens to remove their refuse and convey the same to the boat landings for certain sums of money. The haul was so long from a considerable part of the residential district that we permitted these private contractors to make sanitary fills in low-lying territory, along lines where we knew there must be many feet of fill to be made in streets which were not yet opened.

In 1904 there was a great deal of summer camping along the shores of Puget Sound, and from these campers many and serious complaints were entered because of the amount of refuse which, being discharged from our boats, was washing up on the shores, fouling the beaches and interfering with bathing in the sound. There was also protest being made against the sanitary fills. At this time all the collection work was still being done by private contractors—the city doing nothing but dispose of the material by discharging it into the Sound. About that time it was determined that the city should take over both the collection and disposal and I was authorized to examine the method of disposal in the densely populated European cities. As a result I made a trip to Europe in 1905 and spent some six months in the examination of the results of incinerator operation. It was several years before an incinerator was constructed. When it was put into operation, it was found that of a truth it would burn anything that could be burned and without offensive odors. As a result two others were built and land purchased on which to construct several others. These worked perfectly, reducing every class of refuse to clinker, but, as in the case of disposal by boat, the long haul made it too expensive to bring all of the materials to these incinerators and the cost of construction and operation compared with the scattered population of the suburban districts made it unreasonable to expect that enough incinerators could be built throughout the city to produce short haul.

As a result the sanitary fills were continued, but were put under the inspection of the Health Department. Under careful inspection it was found that this refuse after a week or two, if covered with thin film of earth, would create a temperature of some 50 to 60 deg. C., at which time openings would be made in the earth cover and some offensive odors would be emitted. It was found that by reasonable watchfulness these openings were quickly closed by the use of a little earth and all offensive odors prevented. As a rule a little pinolin was sprayed over the fill on the day that the heat reached its maximum, but this operation was never regarded as very serious because an extra fill of earth quickly cured the trouble.

After the most exhaustive investigations we were able to affirm positively that no house flies were bred in these fills, because the heat generated in the fermentation was such as to cook their eggs.

On the days that a little odor was manifested, a fly, ordinarily termed the bottle fly, used to put in an appearance in quite a good many numbers, but the spray of pinolin seemed to dissuade them from making the dump their residence, and other than this appearance of the bottle fly we have never been able to notice any offense being created by the maintenance of these sanitary fills.

Owing to the expense of long hauling compared with the opportunity offered by sanitary fills, two of our incinerators were closed down in 1913 and the third in 1915 and up to the present date there has been no feeling of a necessity for re-opening either of them, and so far as I can see there will be no attempt to re-open until the population has become very much more dense and we can afford to build such numbers of incinerators as would give a short haul.

All the slops, and in fact all the real garbage from the central part of the city, is collected under the supervision of the Health Department and is sold in bulk to the managers of a large hog farm, who furnish their own trucks and make the collection without any cost to the city, whatsoever. At the present time this hog farm is paying for this material by the ton, the price being fixed at five times the price of pork on foot in the Eastern markets. For instance: If the price of pork on foot in Chicago for today should be 8c. per pound, the hog farm must pay us 40c. a ton for this material. So long as the slops and hotel refuse can be disposed of in this way, it leaves our sanitary fills free from much of the material which might be considered peculiarly offensive. During eight months of the year 60 to 70 per cent of our material is coal ashes. During the summer our consumption of vegetables is much less than that in Eastern cities, as we have to buy corn and melons brought from long distances and the per capita amount used is very small compared with Eastern cities. The vegetables most used here are celery, lettuce, cabbage, potatoes, spinach and beets, and there is very little left of any of these vegetables.

We have complaints against our sanitary fills now and then, but an investigation always proves them to have been unjustified.

I cannot look into the future so as to give any certain statement as to what will happen after awhile. Personally I feel that we ought to return in time to the incinerators, but there are still vast areas here where the sanitary fill can be continued, therefore the return to the incinerators is probably a long way off.

R. H. THOMSON.

Seattle, Wash., March 10, 1923.

[Mr. Thomson was city engineer of Seattle for twenty years and some time afterwards he became a member of the City Council. According to an article published in our issue of Nov. 23, 1922, p. 876, the first of the three refuse destructors of the British (Meldrum) type was built in 1908 and used for five years and the other two were built in 1911 and 1912 respectively, and used three years each. The article cited, based on notes made by a member of the editorial staff of this journal, stated that all three destructors have been "disposed of"; that one of the buildings was torn down, one remodeled for a carpenter shop and one leased for storage. It also appears from the previous article that the hotel and restaurant garbage is collected by owners of a hog ranch; by inference, it appears that all other garbage is collected by the city and goes to the sanitary fills.—EDITOR.]

Grout and Gravel Packing Around Tunnels

Sir—The article by W. E. Thompson, "Effects of Grouting and Gravel Packing Around Tunnels," in your issue of April 5, contains information of great value in connecontion with shield tunnels in sandy ground, since the construction of the station at Willoughby and Lawrence Sts. is the first time that the ground overlying a tunnel in which gravel packing and grout had been used was excavated from the surface of the street to the bottom of the tunnel. As Mr. Thompson was engaged on the original tunnel work he also speaks with authority as to the results obtained at the time the tunnels were driven.

In the original work, after the Flinn-O'Rourke Co. drove the tunnels, timber drifts like that shown in Fig. 1 of the article were driven for about 600 ft. above the tunnels in Clark St. and Montague St. for the construction of inter-track stations. At that time the space between the tunnels was excavated from the top drift down to the bottom of the tunnels and three segments of cast-iron lining were removed from each side. During this work the gravel packing on the sides and top of the tunnel was uncovered and conditions were found similar to those described by Mr. Thompson. The penetration of the grout was only known to the top of the drifts, but it is likely that it penetrates much higher, as in the case of Willoughby St. As this grout was injected to refusal, the character of the ground would naturally fix the height to which it would ascend, and in some parts of Willoughby St., near Flatbush Ave., the grout actually came through the joints in the paving blocks, where the underlying ground was looser than that found at the Lawrence St. station. On Henry St., near the St. George Hotel, where an inrush of sand had occurred at one point, the head of the shield was shoved past the hole left by the escaping sand; the cavity was filled with gravel through tubes through the skin near the front end of the shield, and grout was subsequently forced through these same tubes before the shield was moved. This grout finally appeared in the cellar of the building alongside. Thus, the quantity of grout that can be used above a tunnel necessarily depends upon the amount of spaces the ground naturally contains.

It was also found that the grout did not mingle with the sand and gravel but segregated itself in lumps, some of which were hollow like a bottle because the men did not shut off the compressed air as soon as the grout had been forced out of the grout machine but allowed it to follow up the grout and expand it into a hollow lump. The Transit Commission, I believe, has specimens of these hollow grout lumps.

This method of gravel packing around a tunnel was originated by me some time before the contracts were obtained by the Flinn-O'Rourke Co., and the fact that the shields were provided with gravel tubes at the front end as originally built is evidence that the method was fully in mind before any tunnel work was begun.

Mr. Thompson says, "The overlying cover, about 34 ft., being thick enough to eliminate danger from the release of air at the high pressure of 90 lbs. per square inch necessary to inject the gravel * * * *." Fig. 2 of his article shows a gravel tank with an air line reaching to a tee on a pipe at the bottom of the gravel tank to the other side of which the gravel hose is attached, and connected to a grout hole in the lining at the tail of the shield with a steel nipple. This hose was usually about 25 ft. in length, and the compressed air line was connected to an air supply at the power house. When this question arose as to the possible effect of high-pressure air upon the overlying ground, the writer questioned that the air retained its pressure through the hose and exerted it against the ground outside the nozzle. He had a special nipple prepared containing a valve and air gage. When the valve in the nozzle was closed and the air valve beyond the gravel tank was opened the gage showed full pressure. Air was then shut off and the nozzle valve opened, when the gage dropped back to zero. The usual method of starting the gravel blast was then gone through with, that is to say, the air supply valve was first opened and then the valve in the pipe at the bottom of the gravel tank was opened, permitting the gravel and water in the tank to drop in a stream into the flowing air, which blew it through the hose into the space outside the tunnel. The gage in the nipple remained at zero all the time, showing that the air had fully expanded in the 25 ft. of hose before reaching the nozzle. Therefore no danger need be feared of ill effects from the high pressure used in blowing the gravel, since this pressure released itself in the hose, which it had to do in order to give the velocity with which the air and gravel reached the hose.

The fact that there was no pressure at the nozzle was further shown by holding the nozzle inside the tunnel while the gravel was being blown through it. The stream of gravel and spray was as smooth as a jet of water. The contact of the gravel with the steel nipple like flint with steel made a continuous line of sparks out of the nozzle similar in appearance to a Roman candle, in spite of the spray that was being discharged at the same time. A similar condition may be perceived in the familiar operation of sandblasting the face of stone buildings. If it were true that the 100-lb. pressure used in gravel packing remained unchanged throughout the hose the velocity would be only one-seventh what it is when fully expanded, which expansion would have to be resisted by the gravel acting as a valve to maintain this pressure, which is obviously absurd. Therefore, the only pressure that the gravel-blowing method exerts is what might be due to the velocity of the air or the wind pressure, which would be less than 100 lb. per square inch. In the case of clay or other ground impervious to air, the space between the lining and the end of the shield can always be relied on to give a vent for the air from the gravel blast into the tunnel.

The reason for taking so much time to discuss this matter is the fact that this belief in high pressures is very much against the use of gravel in connection with subaqueous work, where no undue pressures should be introduced outside the tunnel lining, as these would have an unfavorable effect upon the overlying cover. However, anyone can prove to his own satisfaction that no such pressure exists, by simply placing a gage on the nozzle inside the tunnel, which would show a pressure if there were one. Being naturally very much interested in this matter of safe tunneling by the use of grout and gravel packing I feel under great obligation to both Mr. Thompson and *Engineering News-Record* for this publicity of the proof of their usefulness

New York City, April 10. JOHN F. O'ROURKE.

Gasholder Welded in England

Electric welding was applied in the reconstruction of a gasholder in England recently. The original holder, 200 ft. in diameter, and of 3,000,000 cu.ft. capacity, had been destroyed by fire, so that little of its structure could be salvaged. The brick tank, 200 ft. in diameter by 36 ft. deep, and a part of the guide framing could be used, the latter after extensive repairs. The three-lift holder, however, as well as the guides, had to be replaced. The three lifts, ranging from 191 ft. 6 in. to 197 ft. 6 in. in diameter by 34 ft. 9 in. deep, are made of $\frac{5}{16}$- and $\frac{1}{2}$-in. steel. All the sheets were connected by welding. The Z-shaped stiffener stays on the inside of the upper lift were also connected and attached by welding. It is reported that although the holder contains more than 20 miles of welded joint, only two or three small leaks were detected on test. Under the circumstances of the work, no definite cost comparison with riveted work could be made, but estimates by an experienced engineer of gas plant construction are quoted to the effect that the labor time amounted to less than half that which would have been required in riveting. The speed of the welding work is given as 15 ft. per hour on overhead and horizontal fillets and 12 ft. per hour on vertical fillets.

News of the Week

CURRENT EVENTS IN THE CIVIL ENGINEERING AND CONTRACTING FIELDS

News Brevities

The Great Northern R.R. Co. is planning to spend $30,000,000 during 1923 on new equipment, terminal expansion and double tracking.

By the Provisions of a Measure introduced at Albany the time in which the licensing law in New York becomes effective would be extended from the present date, May 5 until August 1, 1923.

Bills Have Been Introduced at Albany, N. Y., to appropriate $740,000 for the completion of the state owned hydro-electric plant at Vischers Ferry, N. Y., $30,000 to complete the tailrace at the Crescent Dam plant, and $200,000 to construct a barge canal terminal at the city of Rensselaer.

The Wabash R.R. Co. Reports a net income of $1,210,388 for 1922 as against $1,281,361 for last year. The outstanding achievement during the year was the reduction of the ratio of expenses to revenues from 85.29 per cent in 1921 to 83.31 in 1922.

In a Referendum of the New York State members of the American Society of Mechanical Engineers, 1,630 members voted for and 185 against action by the society aimed at securing a postponement of the date on which registration of professional engineers becomes mandatory in New York.

Articles of incorporation have been filed with the Illinois Secretary of State by the National Transportation Institute. The purpose of the institute is to conduct non-partisan and impartial investigations into all kinds of transportation questions and to disseminate the facts so acquired to the public through the platform, press, motion pictures, and educational institutions.

Bids Have Been Called for by the Board of Estimate and Apportionment of New York to be submitted May 13 for the construction of the South Street Shaft, St. George, Staten Island. for the freight and passenger tunnel the city is building under the Narrows between Brooklyn and Staten Island. Contracts will call for the completion of the shaft within 12 months of the date the award is made.

The City of San Francisco has called for bids to be opened May 16 on 19½ miles of 5-ft. steel pipe for conveying water across lower San Francisco Bay, this crossing to be used immediately after completion by the supply being brought in from Calaveras sources and later to become a part of the Hetch Hetchy aqueduct. Bids are also to be opened on May 23 for the steel penstocks involving 7,900 tons of riveted steel pipe or 6,000 tons of welded steel pipe needed for the Moccasin Creek power house of the Hetch Hetchy project.

Pottery Makers Get Prison Terms

Eight members of the Sanitary Potters Association, New York, who last week were convicted of violating the Sherman anti-trust law by price-fixing, have been given both heavy fines and prison terms. Sentence was pronounced by Justice Van Vleet, of the Federal Court. Fines were imposed on 12 other defendants and on all the companies named in the indictment.

The heaviest sentence, ten months, was given the president of the association, Thomas Maddock, of Trenton, N. J. He was also fined $5,000. The other seven were given six-month terms and fined $5,000. Fines of $5,000 were imposed on most of the defendant companies. Total fines aggregated $169,000.

The defendants were charged with price-fixing, the indictment following disclosures made by the Lockwood Joint Legislative Committee on Housing. Samuel Untermyer, in commenting on the case, asserted that "this is the first contested case in the Federal Court in which there has been a conviction," adding that it would probably be a year at least before prison sentences were begun, inasmuch as an appeal will be taken.

New Jersey Conference Discusses Grade Crossings

The fact that the present method of protecting highway crossings is entirely inadequate was brought out at a conference held at Trenton last week under the auspices of the Board of Public Utilities Commissioners. The conference was attended by representatives of the American Railway Association, the State and Highway County Commissioners, and of the railroads operating in New Jersey.

The conference opened with a descriptive display of the types of track circuit signals and approach warning signs recommended by the Signal Section of the A.R.A. This was followed by a discussion of the dangers of the present methods of crossing protection, including gates and flagmen, with suggestions for the improvement of such protection. This led to the matter of approach warning signs and the need of removing all signs of an advertising nature, particularly signs with flashing lights, from the vicinity of all grade crossings. It was decided that this should be done for at least 500 ft. each side of every crossing and that the approach warning sign should be set 300 ft. from the crossing.

In concluding the conference expressed its approval of alternately flashing red lights as a warning signal to be displayed at grade crossings upon the approach of trains. It also approved of the offer of the railroad companies to supply approach warning signs for all crossings not already equipped, and recommended to the highway authorities that they keep in touch with the railroad officials so that they could erect the signs as soon as they were supplied.

Delaware & Hudson Co. Celebrates Centenary

Gala Dinner Brings Together Railroad Men, Bankers Industrial Leaders and Publicists

The 100th anniversary of the founding of the Delaware & Hudson Co. was celebrated in New York, April 23, at a gala dinner which brought together a distinguished gathering of railroad men, bankers, industrial leaders and publicists. The company was organized under charter from the New York Legislature to build a canal for the transportation of coal from the anthracite fields to the New York City market. Canal construction was begun in 1825 and, though locomotives were brought from England in 1829 for operating an 11-mi. stretch of railroad spanning a break in the canal system, steam operation was never effective because the locomotives were too heavy for the track structure. In 1867 the Delaware & Hudson Co. began the construction of its present steam railroad system.

The chief speakers at last Monday's dinner were L. F. Loree, president of the company, James S. Alexander, president of the National Bank of Commerce, New York, and H. W. Dickinson, of London, honorable secretary of the Newcomen Society and assistant to the director of the South Kensington Science Museum.

Mr. Loree, after tracing the development of railroad transportation in the United States and its influence upon national development, made a plea for a sane business attitude toward our railroad systems. Further progress in stifling regulation would lead to destruction.

Mr. Alexander discussed in detail the influence of transportation upon industrial and agricultural development, making a particularly striking point of the dependence of the liquidity of commercial credits upon regular and speedy functioning of our railroad system. Unless manufacturers' goods can be quickly transferred to the purchaser, the manufacturer cannot discharge his bank loans and thus make commercial credits available to other industrial units.

Among those present were Samuel Rea, A. H. Smith, Daniel Willard, Newcomb Carlton, Eugene G. Grace, Frank A. Vanderlip, Herman H. Westinghouse, Guy E. Tripp, Owen D. Young, Charles A. Stone, Charles M. Schwab and W. L. Saunders.

To Finish St. Paul Union Station

A contract awarded recently by the St. Paul Union Depot Co., St. Paul, Minn., to Foley Bros., of that city, provides for the completion of the new union station. The total cost of this work will be about $2,000,000, of which probably $900,000 will be spent this year, the remainder of the work being extended over the next two years. W. C. Armstrong is chief engineer of the company.

Am. Soc. C. E. Holds Successful Meeting

Three Days at New Orleans Devoted to Discussion and Inspection of Lower Mississippi and Its Problems

Engineering News-Record Staff Report

About 110 members were registered at the spring meeting of the American Society of Civil Engineers at New Orleans, April 18 to 20, but nearly twice that many guests, both men and women, swelled the attendance. The technical sessions, reported on another page of this issue, were devoted to a discussion of the problems of the lower Mississippi, and the nearby river was utilized as an exhibit. One whole day was devoted to a boat ride up the river above the port works and down to the site of the Poydras crevasse and through the not yet officially opened Industrial Canal into Lake Pontchartrain. The river was at high water, within three feet of the record of last year, so that the visitors could get an impressive reaction to the dangers and difficulties involved in passing so great a volume of water by a large city lying well below the high water level.

HOSPITALITY GENEROUS

The New Orleans engineers bore out their reputation for generous hospitality. Those who were in the city for the day before the opening, including the board of direction of the society, were entertained at luncheon and at dinner, while those attending the convention were taken for trips through the old French quarter, with appropriate entertainment, and for a ride around the city terminating at the country club, where the accompanying photograph was taken.

The action of the board of direction in the two days' session before the meeting was reported in last week's issue. No business was transacted by the society in its regular business session but future quarterly meetings were announced, as follows:

July 11-13, Chicago, subject, transportation;

October 15 or thereabout, two days at Richmond, Va., one day at Norfolk and one day at Washington, subject, highways.

N. Y. License Law Effective May 5

Little more than a week remains in which to file application for engineers' licenses in the State of New York. The law becomes effective May 5, after which date any engineer practising in New York State without a license is subject to fine and imprisonment. Also, after that date, an examination is necessary to obtain a license. The University of the State of New York advises that any application dated as late as May 5 and mailed prior to midnight of that date will be accepted as received in time, and that the board is taking the most liberal attitude toward the applications received, not being inclined to quibble over technicalities. Application forms may be obtained from John H. Dunlap, secretary, American Society of Civil Engineers, 33 West 39th St., New York City.

The New Jersey law went into effect April 8. In both laws the privilege of practice during thirty days in any calendar year is extended engineers registered in another state. Practice beyond that period requires separate registration and payment of the full registration fee.

Engineers or surveyors who are working as subordinates under a licensed engineer or surveyor are not required to take out a license.

Chicago Regional Planning Committee Named

Membership in the Chicago metropolitan planning committee of twenty-one named by the City Club of Chicago which will undertake to map out the expansion of Chicago to a city of 8,000,000 people expected in 1950 embracing an area of 1,000 sq. miles includes seven engineers and three architects. The engineers named are S. A. Greeley, consulting engineer, Charles B. Ball, chief sanitary inspector, Department of Health, Eugene A. Rummler, patent attorney, J. G. Wray, telephone consulting engineer, Herbert E. Fleming, industrial engineer, Langdon Pearse, sanitary engineer, Sanitary District of Chicago, Jacob L. Crane, Jr. city planning engineer. The architects on the committee are, Dwight H. Perkins, G. Herrick Hammond and Daniel H. Burnham, Jr.

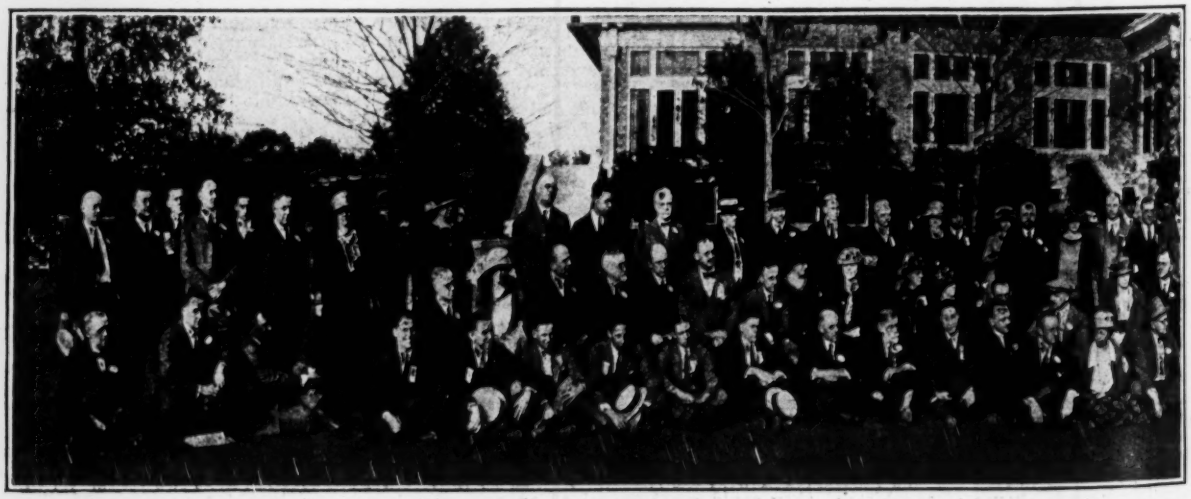
Contract for a 330-Mile Railway

One of the most important railway construction contracts that has been let for some years is that for the Wyoming North & South R.R. (organized as the Montana R.R. for the Montana portion of the line) from Casper, Wyo., to Miles City, Mont., a distance of 330 miles. The purpose of this road is largely the development of oil properties, but it will connect with two trunk lines at each end. Construction has been commenced, but final location for the entire line is not yet completed. With maximum grades of 1 per cent the earthwork is estimated at between 7,000,000 and 8,000,000 cu.yd. The contract for grading and bridging has been awarded to Roberts Brothers, Peterson, Shirley & Gunther, with offices at 17 North La Salle St., Chicago, and Woodmen Building, Omaha, Neb. D. C. Fenstermaker is chief engineer, and George M. Huss is engineer of construction.

New York Engineers Favor Benevolent Fund

Action in favor of a civil engineers' benevolent fund and in favor of continuing present co-operation in an engineering employment service was taken by the New York section of the American Society of Civil Engineers at an active meeting held on April 18. In both cases the action followed the presentation of thoroughly prepared reports of special committees. Ralph Modjeski and H. E. Blake were appointed to develop a plan for the reconstruction of High Bridge over the Harlem River to avoid the necessity of removing it in connection with improvement of navigation clearance on the Harlem. The proposal to remove the structure is now before the Board of Estimate of New York City, but the board has agreed to delay decision on the matter until representatives of the section and of the local chapters of the American Association of Engineers and the American Institute of Architects have opportunity to present a plan for saving the historic structure.

"Ancient Engineering" was discussed in a series of addresses by Prof. C. J. Tilden, Ralph Modjeski, Prof. William H. Burr, Gen. W. B. Parsons and others.



MEMBERS OF THE AMERICAN SOCIETY OF CIVIL ENGINEERS, AND GUESTS, IN FRONT OF

Philadelphia Proposes Bills to Start Huge Water Program

Two ordinances are pending before the Council of Philadelphia, providing funds to make a start on a 15-year program for extensions and improvements of the water supply of Philadelphia to cost a total of some $75,000,000. The first of these ordinances appropriates $5,000,000, to be available in 1924, for the development of water in Perkiomen, Tohickon and Neshaminy drainage areas, together with the necessary extensions of existing works within the city limits to meet the growth and development of the city. The intention is to incorporate this $5,000,000 item in a comprehensive loan ordinance to be submitted to popular vote next fall. The ordinance states that the $5,000,000 appropriation is the first of four proposed similar appropriations to cover the first four years of the entire program. The second ordinance is $100,000, to be used on preliminary work looking toward the construction of the first storage reservoir on the Perkiomen at Green Lane. This sum would be available about June 1. A report on the extensions to the Philadelphia water supply made by a committee of consulting engineers, consisting of J. W. Ledoux, Philadelphia, chairman, George W. Fuller and J. Waldo Smith, New York City, and Joseph S. Hasskar, Philadelphia, was abstracted in *Engineering News-Record*, Oct. 14, 1920, p. 751. Carlton E. Davis is chief of the Philadelphia Bureau of Water.

Bonds to Finance Hudson River Bridge at Bear Mountain Offered

Bonds for financing the construction of a highway bridge over the Hudson River between Bear Mountain and Anthony's Nose, just above Peekskill, N. Y., were offered to the public during the past week by the banking firm of W. A. Harriman & Co. The bridge, whose preliminary plans were described in *Engineering News-Record* of Feb. 23, 1922, p. 326, is estimated to cost $5,000,000. The bond issue is for $3,000,000, at 7 per cent, and is offered at 98½. The common stock and an issue of $1,500,000 of notes has been taken by private subscription.

To Hold Engineering Exhibit

The Joint Committee on a National Museum of Engineering and Industry proposes to hold in the Engineering Societies' Building, New York, during the coming fall and winter an exhibit of records, charts, drawings, pictures, models and other material illustrative of the steps supplied by the engineer in the development of the United States. The primary object of the exhibit is to arouse interest of the engineers and the public generally in the project in hand with the Smithsonian Institution to establish a national museum of engineering and industry, with headquarters at Washington and branches in various sections of the country.

500,000 More H.P. in Sight

The Susquehanna Power Co. has applied to the Federal Power Commission for a license to construct a hydroelectric plant on the Susquehanna River at Conowingo, Md., the ultimate installation to be 360,000 hp. It is their intention to construct a dam 100 ft. high, which will create a pool extending 25 miles up the river to McCalls Ferry at Holtwood, Pa. It is also reported that the Pennsylvania Water and Power Co., will develop the power immediately above its Holtwood plant. Such a plan would develop slack water in the Susquehanna from tide water to the vicinity of Harrisburg, and would pave the way for the utilization of these pools for navigation.

On April 7 the Alabama Power Co., put its first 24,000 hp. unit into operation in Mitchell Dam at Duncan's Riffle on the Coosa River in Alabama. Two other units of the same capacity will be put into operation within the next two months. Work on the dam was authorized on July 14, 1921; the first concrete was poured in January, 1922; and the dam was completed on January 1, 1923. The company is also pressing its investigations on the Tollopoosa River in the hope of developing its large power resources in the near future, and has applied to the Federal Power Commission for a license covering the installation of a 5,000 hp. unit at Government Dam No. 17 on the Black Warrior River. License for a similar unit at Dam No. 16 will be asked in the near future.

Louisville & Nashville to Spend $50,000,000 on New Work

During the past few months the Louisville & Nashville R.R. Co. has authorized a total expenditure of nearly $50,000,000 for new work, and in addition it has under active consideration other projects involving many more millions of dollars, but the plans for the latter are not yet sufficiently definite for actual figures. The program definitely authorized contemplates the construction of fifty miles of second track and grade reduction work, the installation of new and enlarged terminal facilities, the building of additional side and passing tracks, new bridges, and various other projects designed to enlarge and improve the service. Although some of the work has been completed, the greater part consists of improvements now under way and scheduled for completion during the current year.

In regard to equipment, this company has under contract for delivery during 1923 a greater amount than in any other similar period during its history, having recently authorized a total of 86 locomotives, 11,000 freight cars and 51 passenger cars of various classes. Some of this equipment has already been delivered.

It is explained by the president, W. L. Mapother, that this company does not employ the budgetary system but undertakes to authorize and prosecute its improvement work as conditions require or future prospects seem to justify: "We are quite cognizant of the decidedly optimistic trend of business activity and are exerting every effort to increase our transportation plant in order to meet the present and prospective requirements."

North Carolina Contracts Large Highway Mileage

On April 3 the North Carolina State Highway Commission let contracts for sixteen projects, totaling 126.37 miles, and costing $2,697,754, exclusive of the usual 10 per cent for engineering and contingencies. Of this mileage 54.97 miles were either of concrete, or asphaltic surface on 5-in. concrete base. The average cost per mile for this work was $31,644.

THE NEW ORLEANS COUNTRY CLUB DURING ANNUAL MEETING OF SOCIETY, APRIL 18-20

Traffic Association to Meet in New York, May 10

The 1923 annual meeting of the National Highway Traffic Association will be held at the Automobile Club of America, 247 West 54th St., May 10. The afternoon session will be taken up with the reports of eight committees, following which an informal dinner at the club will take place. The evening meeting will be devoted to a continuation of the hearing of committee reports. In all, the following twelve committees will report:

(1) On traffic center lines on roadways, (2) status of the construction of highway curves and recommended practice to increase safety to traffic, (3) highway danger signs, (4) mechanical devices for highway traffic regulation, (5) regulations covering speeds, weights and dimensions of motor trucks and trailers, (6) regulation of overloading of motor trucks, (7) rural motor express, (8) highway transport clearing houses, (9) safety regulations at railroad grade crossings, (10) equitable distribution of cost of construction, interest on bonds, replacements, and maintenance of state highways, (11) highway transport franchises, and (12) the demand for national transportation and the function of streets and highways.

Engineering Library Dedicated in Denver

On Apr. 7 representatives of the Denver city library, of the state and of the engineering profession, attended exercises at which a technical library of applied science was dedicated in Denver, Colo. Acquisition of such a library has been one of the objects of the Colorado Engineering Council, of which L. G. Carpenter is president, ever since its organization.

The need for such a collection of books for reference has been felt for years by engineers in the West, whose nearest collection of such volumes was at least a thousand miles distant. This distance from the largest center has made it difficult for engineers either to keep up with current developments or to take advantage of consulting books when they are doing investigation work.

The new library is maintained in the City Library Building and the collection of books is loaned from private engineering libraries and by the state, which has purchased with money from its State Board of Engineering Examiners fund a number of volumes. The State Board of Architects also supplied money with which to purchase part of the library.

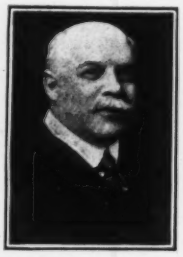
It is hoped to make the library available as a loaning collection to engineers in Colorado whose fees have contributed to the collection.

Engineer on Morris Canal Board

Cornelius C. Vermeule, consulting engineer of New York City, has been named by Governor Silzer, of New Jersey, one of five members of a board to investigate the problem of what shall be done with the Morris Canal. This state board, together with five men appointed by municipalities through which the canal passes, and two members of the State Board of Conservation and Development, were scheduled to hold their first meeting yesterday.

Dr. Burgess Named Director of Bureau of Standards

Dr. George K. Burgess has been appointed director of the U. S. Bureau of Standards. Since 1913 he has been chief of the Bureau's Division of Metallurgy. Born in Newton, Mass., Jan. 4, 1874, George K. Burgess received the degree of B.S. from Massachusetts Institute of Technology in 1896, held a fellowship there from 1898 to 1900 and obtained his Sc.D. at Paris in 1901. He served short terms as instructor at the University of Michigan and at the University of California before coming to the Bureau of Standards in 1903.



After two years as associate physicist there, he was physicist from 1905 to 1913. In the latter year he was raised to the rank of chief of division.

Dr. Burgess has been active in the work of the National Research Council. During the war, in addition to his regular duties, he was an advisor to the requirements division of the War Industries Board and to the Ordnance Department of the Army. In 1917 and 1918 he was chairman of the light alloys committee of the National Advisory Committee for Aeronautics. During the same period he was a member of the National Aircraft Standards Board. He was the recipient of a silver medal at the Pan American Exposition held in 1915. He is this year's president of the American Society for Testing Materials.

California Stadium Under Way

A stadium with a seating capacity of 73,000 is now under construction in the Berkeley hills adjoining the University of California campus and the intention is to have it ready in time for the Thanksgiving day Football game this year between the University of California and Stanford University. The location is in a small valley where by sluicing earth from the uphill side and diking the downhill side an oval can be laid out in which about two-thirds of the seats will be placed directly on earth foundation. The remainder, chiefly on the ends and the westerly or "downhill side," will be supported by a concrete structure whose outer wall will be treated architectually so as to give the stadium the outward appearance of an early Roman Coliseum.

The playing field is of elliptical form with major and minor diameters of 459 and 267 ft. respectively. The seats, supporting structure and outer wall on the downhill side will be of concrete. About 300,000 cu.yd. of earth and rock is being moved to form the substructure and this work was about 25 per cent complete on April 15. The material is being excavated and placed hydraulickally at the rate of 3,000 cu.yd. per day with the aid of two 4½-in. monitors. The total cost is estimated to be about $1,100,000.

E. E. Carpenter, consulting engineer, is the engineer member of the Stadium Commission under which the work is being done. The contract on earth moving is held by Bates and Borland.

Postpone Colorado River Action

Washington Correspondence

No action will be taken on water power projects on the Colorado River at this time. Formal action to this effect was decided upon Monday by the Federal Power Commission after the matter had been the subject of discussion at a meeting of the President and his cabinet. This decision of the commission is a victory for the State of Colorado in particular. Colorado is anxious that this pressure be brought to bear on Arizona in the hope that speedy ratification of the compact will follow. The staff of the Federal Power Commission insisted at the meeting that there is no reason other than that of holding a club over Arizona, why rights should not be granted for the more urgent of the projects.

The commission also decided to withhold action on the Flat Head Lake project until the Goodwin commission will have reported.

Will Investigate Fatigue of Copper and Non-Ferrous Alloys

Extension in a new direction of the fatigue-of-metals investigation which has been in progress for several years past at the University of Illinois has just been announced. The work so far has been done by co-operation between the Illinois Engineering Experiment Station, Engineering Foundation, and the National Research Council, with support by the General Electric Co., and has been confined to rolled steel, but it is now to be extended to the fatigue of copper, brass, bronze, and other metals, in collaboration with the Copper and Brass Research Association, the General Electric Co., the Western Electric Co., and other concerns. A fund has been provided to make this research extension possible, and the experience and commercial assistance which the co-operating corporations can render will be available. Efforts are also in progress to extend the research to steel castings. The work will continue under the direction of Prof. H. F. Moore. Its active promotion is in care of Alfred D. Flinn, director of the Engineering Foundation.

Plan Survey of Government's Building Needs

Washington Correspondence

A systematic survey of the building needs of the federal government throughout the country, with all possible construction by the government delayed in order to give private contracts priority in the demands upon materials and labor, and the beginning of the government program when activity in the building industry slackens, are recommended in a plan proposed by Representative Martin B. Madden, chairman of the House appropriations committee.

The Madden plan is in harmony with the suggestion of Secretary of Commerce Hoover expressed in a recent letter to the President. (See *Engineering News-Record*, March 12, p. 562.)

While these moves are under way, the Public Buildings Commission of Washington, of which Senator Smoot is chairman, has announced that when Congress convenes it will urge the appropriation of $15,000,000 for the erection of buildings in Washington.

Engineering Societies

Calendar

Annual Meetings

NATIONAL CONFERENCE ON CITY PLANNING, New York; Fifteenth Conference, Baltimore, April 30-May 2.

AMERICAN ASSOCIATION OF ENGINEERS, Chicago; Annual Convention, Norfolk, Va., May 7-9.

NATIONAL FIRE PROTECTION ASSOCIATION; Boston; Annual Meeting, Chicago, May 8-10.

NATIONAL HIGHWAY TRAFFIC ASSOCIATION, New York; Annual Meeting, New York, May 10.

AMERICAN ROAD BUILDERS ASSOCIATION, New York; Annual Meeting, New York, May 15.

AMERICAN WATER WORKS ASSOCIATION, New York City; Annual Convention, Detroit, Mich., May 21-25.

SOCIETY FOR THE PROMOTION OF ENGINEERING EDUCATION; Annual Convention, Ithaca, N. Y., June 23-25.

AMERICAN SOCIETY FOR TESTING MATERIALS, Philadelphia; Annual Meeting, Atlantic City, N. J., June 25-29 or 30.

The Electric Steel Founders Research Group met at East Aurora, N. Y., Apr. 13 and 14. W. H. Worrilow, of the Lebanon steel foundry, presided. The following papers were read: "Electric Steel Castings for Specialties" by W. J. Nugent, Chicago; "Properties of Electric Steel Castings and Where They Should be Used" by T. S. Quinn, of Lebanon, Pa.; "Cost Accounting" by L. S. Persgoy, Milwaukee; "Salesmanship" by J. C. Redmond, of Detroit. Discussions dealt with co-operative effort in steel foundry research, with systematic production planning, with progress in the effort to maintain and improve the quality of electric steel castings, with new uses for electric steel castings, and related subjects.

The Detroit Engineering Society will hold its twenty-ninth annual meeting and banquet at the Cadillac Hotel, April 28. Dean F. Paul Anderson, of the University of Kentucky, Mayor Frank E. Doremus, of Detroit, and President David Friday, of the Michigan Agricultural College, are among the speakers.

Personal Notes

FRED G. SIMMONS, recently appointed state engineer of Oklahoma to succeed Max L. Cunningham, gained his early professional experience in Denver, Colo., where from 1889 until 1897 he was in charge of tracks and paving for the Denver Tramway Co. In 1897 he moved to Milwaukee, Wis., where he became engineer of way and structures for the Milwaukee Electric Railway & Light Co. This position he held for fifteen years. In 1912 he was appointed commissioner of public works of the city of Milwaukee and after 5½ years resigned and entered consulting practice. Mr. Simmons is a past president of the American Electric Railway Engineering Association. He assisted in the organization and is past president of the Engineering Society of Wisconsin. For many years he was a member of the American Railway Engineering Association, prominently identified with committee work.

L. A. MILLER, since 1920 with the Massillon Bridge & Structural Co., has been made chief engineer of that company. He was formerly in the office of the supervising architect in Washington, and previous to that with the Worden Allen Co. of Milwaukee, Wis.

EDWIN J. BEUGLER, for the past three years with The Foundation Co. and for the previous fifteen years with Westinghouse, Church, Kerr & Co., as consulting engineer and as chief engineer, has established consulting engineering offices in Cheshire, Conn. Particular attention will be given by Mr. Beugler to railway, water-power and foundation examinations and reports.

E. C. HINGSTON, formerly in engineering work in Chicago, has become associated as general superintendent with the Flick Construction Co. of Herington, Kans. The Flick company has recently been awarded the contract by the Rock Island system for its double-track grading between Topeka and Herington.

C. N. MONSARATT, consulting engineer of bridges, Toronto, Ont., has been appointed consulting engineer of the operating department, Canadian National Rys., Montreal.

H. RINDAL, district engineer of the British Columbia district, Vancouver, has been appointed district engineer of the Alberta district, Canadian Pacific Ry.

F. B. GOEDIKE, a graduate of Queens University, has been appointed engineer of the Township of York, Ont.

S. A. SEELY, formerly supervisor of bridges and buildings for the New York Central R.R. at Watertown, N. Y., and most recently the assistant division engineer of the Adirondack and Ottawa Division of that road has been appointed division engineer of the same division, with headquarters at Utica.

DWIGHT P. ROBINSON & CO., INC., engineers and constructors, New York City, have opened an office in Philadelphia, under the direction of CARL A. BAER, recently with the firm of Baer, Cook & Co., engineers.

WALTER B. CALDWELL has associated with him W. G. KIRCHOFFER of Madison, Wis., for the practice of civil engineering with special attention to sewerage and water supply work in the eastern district of Wisconsin. Mr. Caldwell maintains consulting offices in Waukesha.

PHILIP B. HILL has disposed of his engineering practice in Little Rock, Ark., where he has been established for the past seventeen years, to GLENN D. DOUGLASS, also of that city. Mr. Hill has become associated with the Continental Rock Asphalt Co. in Big Clifty, Ky.

BENJAMIN F. LAMSON has been appointed city engineer for St. Catharines, Ontario, Canada.

GEORGE F. STAAL has resigned as city engineer of Milwaukee, Wis., and will take up private practice at Denver, Colo. He has served three terms of three years each and his third term expired April 17. He was assistant city engineer for some time and previously was engineer of maintenance-of-way for the Milwaukee Electric Railway & Light Co.

J. A. STALLINGS, formerly of the North Carolina State Highway Commission has been appointed county highway engineer for Wake County, N. C., with headquarters at Raleigh.

THE BURNS & MCDONNELL ENGINEERING CO., of Kansas City, Mo., for the past twenty-five years specialists in municipal engineering problems, have opened an engineering office in Los Angeles, in the Marsh-Strong Building, with Chester A. Smith, a member of the firm, in charge.

C. I. FELPS has resigned as assistant state highway engineer of Kansas, the resignation taking effect April 1.

RUDOLPH P. MILLER, former superintendent of buildings for Manhattan and the first chairman of the Board of Standards and Appeals of the City of New York, has resumed private consulting practice at 25 West 45th St., New York City. Matters relating to the construction, use and occupancy of buildings are the special field in which Mr. Miller offers his services. Particular attention will be given to appeals and petitions to the Board of Standards and Appeals, interpretations of the laws relating to buildings, inspection and survey of buildings, soil examinations, testing of materials of construction, arbitration of disputes, expert testimony in litigations, formulation of building codes, and the preparation of zoning plans for municipalities.

Obituary

ADISON LINDSLEY, civil engineer of Portland, Ore., and formerly one of the locating engineers of the Northern Pacific R.R., died in Portland, April 13. At one time Mr. Lindsley was city and county engineer at San Francisco, Calif.

BENJAMIN F. THOMAS, who had been in the service of the United States Engineering Department for the past forty years, died at his home in Catlettsburg, Ky., Apr. 14. He had resigned from the service the day before his death. He was 67 years of age.

FRANK A. RAPP, bridge engineer for city of Seattle since 1912, despondent because of an incurable illness, shot and killed himself at his home recently. Mr. Rapp designed nearly all of Seattle's important bridges, including the three bascule type bridges that cross the Lake Washington ship canal, plans for the Spokane street steel bridge now under contract, steel arch over Ravenna Park Ravine, and concrete arch that carries the penstock across Cedar River.

From the Manufacturer's Point of View

A Point of Contact Between Maker and User of Construction Equipment and Materials

Machinery Export Plans for 1923—The Far East

Markets of Asia Expanding—Volume of Machinery Trade in 1921 Totaled $64,400,000

By W. H. Rastall

Chief, Industrial Machinery Division, U. S. Department of Commerce

(The following article is the third and last of a series on the world markets for American industrial machinery and the outlook for 1923. *The first article (Feb. 8, p. 279), outlined the foreign-sales problem for* 1923 *in its more general aspects and contained a table showing the comparative value of the more important machinery markets of the world, as indicated by American export statistics for* 1910, 1913, 1919, *and* 1921. *The second article (Feb. 22, p. 370), discussed the Latin American markets. The third and final article, which follows, deals with the Far Eastern markets for American machinery and should be considered in connection with the tables, charts, and information published in the two issues of "Engineering News-Record" previously referred to.)*

NOTWITHSTANDING the fact that Japan, the best of the Asiatic markets for American machinery, ranks only fourth among the markets of the world, it should be emphasized that the Asiatic group shows signs of rapidly increasing importance and possibly deserves more attention than the present volume of business might suggest. All five of the leading Asiatic markets rank better than 13 among our machinery markets. Of our total machinery exports the Asiatic markets took 7.4 per cent in 1910, 6.8 per cent in 1913, 22.9 per cent in 1919, 18.5 per cent in 1920, and 26.1 per cent in 1921. In other words, the comparative importance of the Asiatic group, as expressed in percentages, has expanded about three and one-half times in the last decade, and, as was indicated by the table published in the Feb. 22 issue of *Engineering News-Record*, the value of American machinery absorbed by Asia rose from $3,800,000 in 1910 to $64,400,000 in 1921.

Markets of Asia Expanding

As contrasted with the markets of Europe, which are contracting, the markets of Asia are showing most satisfactory expansion, and it would appear that constructive sales effort would yield the best returns when applied to expanding markets. Most of the countries of Asia are very densely populated and show indications of being capable of marked industrial development, as contrasted with markets in many other parts of the world in territories that have been developed more recently, where there is a lack of adequate population, even when it is known that the natural resources justify exploitation. South America, Australia, and other sections have their immigration problems, but with Asia it is more a matter of raising the standard of living, and very rapid progress is being made in this direction.

It is a mistake to think of Asia as the "unchanging East." Railways are being developed, shipping increases rapidly from year to year, mines are being opened, industries are being established, highways are being constructed, automobiles and trucks are being placed in service, and in a great many other ways the entire continent is showing signs of absorbing an ever-increasing volume of mechanical equipment of great variety. In mapping out a sales program for the current year the foreign-sales manager should make ample allowance for these and many other factors.

Japan—This country ranked 4, 4, 8, 10 among the world markets for American machinery in 1921, 1919, 1913, and 1910, respectively, as indicated by the table published in the issue of *Engineering News-Record* for Feb. 8, p. 280. For many years Japan has surprised the world by its industrial development. There is something remarkably consistent about the way in which Japan has developed, and the increase in the volume of machinery that has been absorbed, whether measured in dollars or in the relative importance of this market. Japan is being industrialized. The standard of living for its people has risen very rapidly during the last several decades. Thirty years ago it was a cheap country in which to live; it has become one of the most expensive in the world.

The country is on a gold basis and the exchange situation has not become a problem. On July 30, 1914, the exchange value of the yen was $0.499; on July 31, 1920, it was $0.515; and on Dec. 1, 1922, it was $0.485. Probably the exchange will not get far from the par value, which is $0.4985.

American machinery is rapidly increasing in popularity in this market. In 1910 the United States supplied 20.1 per cent of the machinery absorbed by Japan. In 1919 the share of the United States had increased to 75.4 per cent, but conditions then were abnormal. In 1921 our participation was 52.9 per cent. These figures seem to indicate that more business awaits the American manufacturer in this market if he will take the steps necessary to secure it. Even with this lower participation in the trade, the total volume has been so large as to represent a very remarkable increase in the American share, which has expanded from about $1,700,000 in 1910 to nearly $21,000,000 in 1921.

China—In 1921, 1919, 1913, and 1910, China ranked 5, 7, 28, 15, respectively, among our machinery markets, the volume having increased from about $642,000 in 1910 to more than $18,000,000 in 1921. It would be difficult to find a better record for expansion in both volume and rank.

Chinese exchange always fluctuates very rapidly and widely, as the currency is practically on a silver basis and follows the silver-bullion market. The Shanghai tael on July 30, 1914, was worth $0.60; on July 31, 1920, it was worth $1.065; and on Dec. 1, 1922, $0.713. In the face of disturbed political conditions, unsatisfactory currency systems, inadequate transportation, and a number of other disturbing factors, trade in China expands rapidly in many directions and industrial activity shows rapid development. Moreover, American equipment is becoming increasingly popular in China. Our share of the total machinery trade of that country was 5.8 per cent in 1911, 8.3 per cent in 1914, 30.4 per cent in 1918, and 54.1 per cent in 1920.

British India—This country ranked 8, 15, 22, 19 among our machinery markets in 1921, 1919, 1913, and 1910, the volume of American machinery absorbed by British India having increased from $500,000 in 1910 to $10,700,000 in 1921. Exchange in India has been fluctuating very widely. On July 30, 1914, the value of the rupee was about 32c.; on July 31, 1920, it was 37.25c.; and on Dec. 1, 1922, it was 30.03c. The currency is fast approaching stability.

The industrialization of India has become the avowed policy of both the Government and the public. The imports of machinery are expanding very rapidly, and during recent years the American participation in this trade has shown a marked increase. During the fiscal year 1913-14 the total im-

Road Builders to Meet in New York May 15

The annual meeting of the American Road Builders Association at which time election of officers and directors for the year 1923-24 will take place, is to be held at the Automobile Club of America, 247 West 54th St., New York, May 15. The special nominating committee named in accordance with a temporary constitutional provision, has submitted its list of candidates, and ballots have been distributed among the membership. The vote will be canvassed prior to the general meeting. Following is the list of official nominees:

President, Frank Page; vice-president, northeastern district, E. L. Powers; vice-president, southern district, W. F. Keller; vice-president, central district, S. F. Beatty; vice-president, western district, Samuel Hill; treasurer, James H. MacDonald; directors for one year, northeastern district, J. R. Draney and W. A. Van Duzer; central district, Frank T. Sheets; directors for two years, northeastern district, E. J. Mehren, I. W. Patterson, and W. R. Smith; southern district, H. K. Bishop and J. H. Cranford; central district, C. M. Babcock; and western district, H. S. Carpenter; directors for three years, northeastern district, S. T. Henry, R. Keith Compton, and Fred A. Reimer; southern district, Charles M. Upham and H. G. Shirley; central district, Will P. Blair; and western district, Frank Terrace.

Frank Page, chairman of the North Carolina Highway Commission, who is slated for the presidency of the association, will speak and there will be addresses, also, by other prominent representatives of the highway field.

ports of machinery into India were valued at £6,000,000, of which the United States furnished 1.8 per cent. During the war imports fell off, but the American participation increased rapidly. During the year 1919-20, when the forces of reconstruction had begun to operate, the imports were £8,600,000, of which the American share was 29.3 per cent. During the year 1920-21 the machinery imports were £25,300,000, and although the volume from the United States increased, the percentage fell to 13.7 per cent.

India may be expected to show very rapid development along all industrial lines that its population and resources can support. In spite of the fact that there is a very large volume of native capital available, it should be noted that British capital is flowing into the country at an ever-increasing rate, and the markets of India may be expected to absorb increasing volumes of industrial machinery from now on. Unfortunately the machinery users of India have a very inadequate knowledge of the types of machinery produced in the United States and the uses to which they may be put. India is a large market that deserves careful sales work of a character suited to its development.

Philippine Islands—Among the markets for American machinery the Philippines ranked 11, 8, 11, 18, respectively, in 1921, 1919, 1913, and 1910, and the value of American machinery absorbed increased from $500,000 in 1910 to $5,500,000 in 1921. This represented most of the machinery taken by the archipelago, the American share of the total having expanded from 73.1 per cent in 1915 to 97.3 per cent in 1920. In fact, American influence in this territory is so strong as to make it almost part of the domestic field.

The exchange situation is independent of that of Europe. On July 30, 1914, the Philippine peso was worth 49.9c.; on July 31, 1920, 47.25c.; and on December 1, 1922, 48.2c. Currency has reached reasonable stability.

The sales manager's problem in this territory is one of development, which has been very rapid since the American occupation of the Philippines. In this market one will find endless problems, not the least of which is the comparative scarcity of labor. But, on the other hand, the sugar industry has been expanding rapidly and in the years to come will probably show much further development. In many other directions this market shows great possibilities.

Netherlands East Indies—In 1921, 1919, 1913, and 1910, respectively, the Netherlands East Indies ranked 13, 17, 25, 27 among our machinery markets, value of American machinery exports expanded from $84,000 in 1910 to $5,000,000 in 1921. This has been due largely to the fact that American machinery has become better known in the country since the beginning of the European war. Circumstances connected with the war served to introduce our equipment there, and since then American machinery has been very popular. Satisfactory development of this market, however, depends upon careful sales work.

Excluding machinery for sugar factories, America's share in this trade was less than 2 per cent up to 1914. At that time, however, important progress began and by 1919 (the last year for which data are available), American participation was 34.5 per cent. Of the machinery for sugar factories, the United States supplied less than 1 per cent up to 1915, but its share increased to 36.8 per cent by 1918, after which it fell off rapidly to 4.1 per cent in 1920.

This market offers a difficult sales problem, but inasmuch as it absorbs more than $5,000,000 worth of our machinery a year, and as conditions indicate that a larger participation might be developed, it would appear that the trade deserves the necessary attention. Conditions in this market are obviously related to those in the Netherlands, and the two should be considered jointly.

Exchange is on a reasonably satisfactory basis. On July 30, 1914, the guilder was worth 40.9c.; on July 31, 1920, it was worth 34.4c.; and on Dec. 1, 1922, it was worth 39.6c.

Business in this market has been confronted with very serious problems during recent years. Sugar is one of the most important products, and the reaction of the sugar market has been felt seriously, but as the price of this commodity now approximates 4c., it would appear that the industry is again on a profitable basis. The fluctuations in the rubber market have also seriously affected this archipelago, but in this respect, also, conditions have improved greatly. Java is one of the garden spots of the world, and it would appear that reconstruction has now advanced to such a point that important development may be expected.

Other Asiatic Markets—Conditions in the smaller Asiatic markets, such as the Federated Malay States, Ceylon, Siam, and Indo-China, are to a greater or less extent reflected by those indicated above, and it will be noted that the conditions in the entire territory encourage the expectation of very important developments in the near future. No general rule can be laid down that will apply to the marketing of all kinds of machinery, and obviously it would be folly to expect these markets to employ the more specialized types that have been developed for use in the United States. On the other hand, there is a very definite opportunity to expand the sales of those other types that are suitable for use in these countries.

The machinery markets of Asia are so important and the extension of American participation there during recent years has been so great that a special report on this subject has been prepared by this bureau and will be ready for distribution in the near future. The subject has been treated rather exhaustively, the report totaling 332 pages, well supplied with illustrations, charts, diagrams, and several maps that have been specially prepared to indicate the size and importance of these markets. The volume of the trade of each country, the kinds of machinery absorbed, the nature of industrial development needed, and the methods by which the business should be secured and handled have been treated with very great care. This report is entitled "Asiatic Markets for Industrial Machinery" and can be secured from the Superintendent of Documents, Government Printing Office, Washington, D. C., at a cost of 60c.

Steady Service the Best Index of Equipment Value

Manufacturers continue discussion of policy of featuring "record runs"

By C. F. Messinger
Second Vice-President, Chain Belt Co., Milwaukee

WHILE we certainly are not in favor of the manufacturer advertising record or feature runs, we do believe in performance story advertising. This is based on the thought that the only way to prove to anyone that an article will do certain things is to show that it has done them. We feel that this is the information that purchasers want. On the other hand this information should be qualified and no drastic statements should be made. By this we mean that no mention should be made of a particular day's run but a story of what was accomplished on a given job over a period of time, giving information as to the thickness and width of the concrete road and also the number of actual working hours is justifiable, according to our policy.

By Carl F. Ebert
The Osgood Co., Marion, Ohio

THE policy of the Osgood Co. has been one of strictly adhering to straight line advertising; that is, to develop the merits and capabilities of Osgood products in their true light. The company refrains from publishing record runs or exceptional performances of its machinery because it is recognized that the conditions under which such performances are made are more or less ideal and, therefore, exceptional. If such performances were used as a basis of advertising it would lead to misunderstanding on the part of the prospective users of equipment.

Our machinery is sold purely on its merit, and it is believed that it is so built and constructed that it is unnecessary to use advertising of a doubtful nature in order to put the product on the market. The company makes use of letters in the form of testimonials only through its accredited representatives and direct to the prospective purchaser, thus leaving no possibility of a misunderstanding of the conditions under which the performances are made.

By G. A. Rees
Manager Publicity Department, Chicago Pneumatic Tool Co., New York

IT HAS never been the policy of our company to feature what you term "record runs." We have, however, always been great believers in meritorious performance where equipment has established a record over a period of weeks, months or years. Occasionally mention has been made of some unusual performance for a day, covering probably a riveting operation where one enthusiastic riveter drove an unusually large number of rivets. It is the incentive and the man behind any equipment that count. Much must be left to the imagination in any event. Almost any equipment today will, if there is any manual effort connected with it, perform 50 to 100 per cent more work than it is humanly possible for a man to get out of it, because he cannot stand up to the work day in

and day out and match the capacity of the machine, although he may do so for a few days. The human element must always be considered along with the equipment.

The only way that we can arrive at the true merits of anything is by comparison. If we have a piece of equipment that is doing certain work, and we read in an advertisement that some similar piece of equipment is doing 50 to 100 per cent more work, we conclude that something is radically wrong in our organization. If attention were not drawn to meritorious performance we would go along in blissful ignorance, losing money day in and day out. As soon as we realize what others can do, we set about to do it ourselves.

Not many months ago one of our customers had a riveting job of considerable magnitude, but it was so located that hot riveting could not be done; the rivets to be driven were ⅝, ¾ and ⅞ in. Notwithstanding the fact that we have been manufacturing riveting hammers for more than 20 years, we had never encountered a cold riveting job larger than ½ in., and in consequence we did not realize that the Boyer riveting hammer would drive these larger rivets cold. It was a case of absolute necessity, and in consequence the customer obtained very low carbon rivets, had them carefully annealed before they were used, with the result that the Boyer hammer drove the rivets and made a good watertight job. This was the first time this practice had been attempted for twenty years, so far as our knowledge extended. It was information which should be conveyed to the multitude of users of pneumatic tools, and the only way we could do it consistently was through the advertising pages. It developed great interest and has since solved the riveting problems on many different occasions. We do not consider that it was a "record run," but we do consider it meritorious performance. The customer who started this large work realizes that if a hammer can stand up for three or four months under this exceptional severe task, it earns its value several times over. Some unthinking individual might expect the hammer to stand up for two or three years, just the same as on hot riveting, and in that event an erroneous impression would have been conveyed in his mind, but we cannot record our acts for the unthinking.

BY THE ADVERTISING MANAGER
Of a large company making mining and quarrying machinery

THERE is no doubt but that unscrupulous advertisers may make improper use of "record runs" in an effort to capitalize some performance which their machine has made. On the other hand, most careful advertisers are alive to the danger of such a situation and know that they will be the first ones to be hurt if they make use of material which is capable of misconstruction. The use of record performances is always attended with opportunities for misunderstanding and in order to be valuable and accurate all circumstances of a test or record performance must be stated in the advertising.

However, when properly used—that is, covered by complete statement and with due regard for the truth—such records have a definite value.

Business Notes

UNITED ALLOY STEEL CORP., Canton, O., announces the appointment of the Andrew Carrigan Co. as sales representative on the Pacific Coast. The Carrigan company has offices in San Francisco, Los Angeles and Seattle. It will handle steel and Toncan metal sheets manufactured by the Stark Division of the United Alloy Steel Corp.

LEHIGH PORTLAND CEMENT CO., Allentown, Pa., will construct a complete portland cement plant at Birmingham, Ala., having an annual capacity of 1,000,000 bbl. Dwight P. Robinson & Co. have been engaged to design and construct the plant.

S. C. WILSON has resigned as district manager of the Pittsburgh office of the Whiting Corp., manufacturer of cranes and foundry equipment, to become associated with the Hockensmith Wheel & Mine Car Co., at Penn, Pa. H. E. Reynolds takes his place as district manager in the Whiting Corp.; Mr. Reynolds' previous service was as sales engineer in the company's Chicago office.

H. E. MARKS CORP., Pittsburgh, manufacturer of gypsum roofs, announces the appointment of James M. Hawkins, with offices at 705 Ellicott Square, Buffalo, N. Y., as its Buffalo and Western New York State representative.

THOMAS J. CLAFFY, for more than 26 years a sanitary engineer in the employ of the Chicago Board of Health and for the last 20 years assistant bureau chief, has resigned to open a consulting office.

ALFRED J. FORSCHNER CO., Philadelphia, has been appointed representative for Eastern Pennsylvania, Delaware and Maryland of Sauerman Bros., Chicago, makers of cableway excavators.

Equipment and Materials

Trench Excavator in New Model

A new trench excavator known as the Model 30, designed to meet all requirements on water main and small sewer trenches, is announced by the Parsons Co., Newton, Iowa. This machine is equipped to dig from 18 to 30 in. wide and to a depth of 12 ft. Overall dimensions and wheelbase are reduced to a minimum producing a small compact machine with large working capacity. Power is furnished by a 40-hp. engine. One feature of the trench excavator is the new patented cushioned boom crowding device.

The Model 30 is gear-driven and the main machinery is assembled in one unit with high speed gears, worms and worm gears enclosed and running in oil. The slow traction feed gearing permits three speeds forward and one reverse without adjustments, similar to the automobile gear shift. Steel slat or rubber belt conveyor is optional.

The light weight of this machine, 20,000 lb., makes it adaptable to drainage work.

Masons Trestle of Steel Has Folding and Extension Features

To permit of repeated use on construction work and the transport from job to job in loads of minimum bulk a folding steel trestle, in two models, is being manufactured by the Economy Scaffold Co., of Chicago. The two models are similar in design, except that one has a sliding adjustment by which the height may be varied 2 ft. by increments of 3 in.

These trestles come in a variety of standard sizes. The legs are of high

carbon steel tubing and the cross bar is a steel T. All parts are riveted except at the folding joints, where steel hinged plates are provided. In the adjustable trestle the height may be varied by raising or lowering the tubing and inserting a pin at the required height on either side, as illustrated in the photograph. For this type of steel trestle the manufacturer claims long life, saving in cartage and storage, and a minimum of labor for erection.

Guide for Lettering Drawings

For lettering drawings the Wood-Regan Instrument Co., Inc., New York, manufactures transparent celluloid strips in which openings are cut to guide a lettering pen in forming the letters of the alphabet and numerals. Some of the characters are made with a single motion of the pen, while others require the guide to be shifted to the right or left to complete the character.

The celluloid strip is grooved on its under side so that it may be moved from one letter to another without smearing the ink. Separate guides are provided for several sizes and styles of lettering. The method is known as the Wrico lettering system and for it the manufacturers claim uniformity in the finished work and greater speed than is possible by freehand lettering. For use with the celluloid strips the Wrico lettering pen is recommended.

Publications from the Construction Industry

Piledriving Equipment—UNION IRON WORKS, Hoboken, N. J., has just issued a 92-p. catalog, illustrated, of its piledriving and excavating machinery, grout mixers and equipment for subaqueous foundation work. After a general description of the details of the piledrivers, which are operated by steam or compressed air, the text and illustrations are devoted largely to showing the practical application of the equipment to a varied range of construction operations. Union hammers were used to put down the interlocking steel sheet-piling forming the cofferdams which featured the work of raising the battleship "Maine" sunk in Havana Harbor during the Spanish-American War. Several pages of the catalog are devoted to piledriver leads, one of them mounted on a turntable and another on a derrick car.

Concrete Curing Compound—CAL CHEMICAL CO., INC., Hagerstown, Md., has issued a loose-leaf catalog folder describing the properties and uses of Cal, the oxychloride of calcium in the form of a dry powder which is added to concrete mixtures to reduce the time required for set, increase the strength, and add to the workability and weather-proofness of the mixture.

Construction Mixers—KOEHRING CO., Milwaukee, presents an unusually complete description, with illustrations, of its line of construction mixers, both large and small, in a 94-p. catalog. In addition to general views of each unit, there are illustrations and descriptions of all of the more important mixer parts. The catalog contains a number of useful tables giving such information as quantity of aggregate per batch for different proportions of concrete, quantity of concrete in slabs of various thicknesses, beams, girders and columns, etc. The text includes some useful suggestions on operation of concrete mixers.

Traveling and Gantry Cranes—WHITING CORP., Harvey, Ill., in a new 87-p. illustrated catalog describes its electric traveling cranes for foundries, machine and structural shops, power and coaling stations, and gantry cranes for outdoor service where overhead runways would be expensive. Several pages are devoted to sketches and descriptions of lifting attachments, including chain links, plate hooks, I-beam hooks, plate grips, rail tongs, and grab hooks.

Construction Work—FREDERICK SNARE CORP., New York City, has issued a book of photographs illustrating the varied character of heavy construction work it has executed. Organized in 1900, the corporation, formerly the Snare & Triest Co., has completed about 1,500 different contracts ranging in size from small repair jobs to work involving millions of dollars, both in the United States, the West Indies, and South America. Among the types of work illustrated are piers, lighthouses, foundations, dams, industrial plants, bridges, railways and subways, tunnels, waterworks, and hydro-electric plants.

Piledriving Machinery—VULCAN IRON WORKS, Chicago, in a new 72-p. illustrated catalog, describes its various types of piledriving equipment. The Warrington-Vulcan hammer consists of a heavy ram which is raised by steam but falls by force of gravity only. Detailed operating directions are given. The company manufactures a double-acting hammer, similar in construction to an air drill, designed especially for driving wooden planking or steel sheet piling. The text includes a number of sketches and descriptions of piledriving rigs for various purposes, together with details on standard and special sheaves, head blocks, turntables, pile caps, followers, and pile points or shoes. For cutting off piles at any distance below water surface a pile-cutting saw is manufactured.

Concrete Floors—PORTLAND CEMENT ASSOCIATION, Chicago, has issued a leaflet containing a tabulation of quantities of material per 100 sq.ft. for various types of concrete floor. Assumed unit stresses are stated and the types of floor for which the tabular values are given are illustrated in a page of cross-sectional views.

Business Side of Construction

FACTS AND EVENTS THAT AFFECT COST AND VOLUME

Gary Sees Economic Danger in Immigration Laws

Existing laws restricting immigration are "the worst things for the country's economic future" that could have occurred, according to the report made by Elbert H. Gary, chairman of the board of directors, to the annual meeting of stockholders of the United States Steel Corporation, held in Hoboken, N. J., April 16. Labor abroad is plentiful, Mr. Gary said, and if given the opportunity would gladly come to this country to relieve the present shortage of common labor.

Construction Equipment Exported

Concrete mixers numbering 49 and valued at $56,764 were exported from the United States to foreign countries during December, 1922, according to the records of the U. S. Department of Commerce; 18 of these mixers, costing $28,795, went to Japan, and 13, valued at $16,729, to British India.

In the bucket and belt conveyor field, December exports totalled 110 installations at $24,445, Japan again being the leading consumer.

Dredging machinery weighing 556,500 lb. and costing $78,193, was exported in December, British Honduras receiving the largest quantity of this equipment, amounting to 160,632 lb. costing $33,958.

During the same month 9 cranes costing $60,171 were exported, 3 of them going to Cuba and 2 to Japan.

Hoist and derrick exports for December involved 514 units costing $48,808.

During the same month construction equipment not otherwise specified totalled 817,708 lb. valued at $130,377.

Steel Pipe List Prices Given

List prices, per foot, for full standard weight, black and galvanized, wrought-steel pipe, manufactured by the National Tube Company, Pittsburgh, Pa., are shown in the accompanying table.

STEEL PIPE LIST PRICES

Size	List Price per Foot	Diameters — External	Diameters — Internal	Thickness
⅛	$0.05½	0.405	0.269	0.068
¼	.06	0.540	0.364	0.088
⅜	.06½	0.675	0.493	0.091
½	.08½	0.840	0.622	0.109
¾	.11½	1.050	0.824	0.113
1	.17	1.315	1.049	0.133
1¼	.23	1.660	1.380	0.140
1½	.27½	1.900	1.610	0.145
2	.37	2.375	2.067	0.154
2½	.58½	2.875	2.469	0.203
3	.76½	3.500	3.068	0.216
3½	.92	4.000	3.548	0.226
4	1.09	4.500	4.026	0.237
4½	1.27	5.000	4.506	0.247
5	1.48	5.563	5.047	0.258
6	1.92	6.625	6.065	0.280
7	2.38	7.625	7.023	0.301
8	2.50	8.625	8.071	0.277
8	2.88	8.625	7.981	0.322
9	3.45	9.625	8.941	0.342
10	3.20	10.750	10.192	0.279
10	3.50	10.750	10.136	0.307
10	4.12	10.750	10.020	0.365
11	4.63	11.750	11.000	0.375
12	4.50	12.750	12.090	0.330
12	5.07	12.750	12.000	0.375

Discounts applying on this list are covered by the Pittsburgh basing card of Apr. 19, 1923, published in part in the first issue of *Engineering News-Record* in each month. Warehouse discounts also appear in the Weekly Construction Market, on the last editorial page, covering nine important cities.

Indiana Outlines 3-Year Road Program to Cost $28,000,000

A 1,000-mile state road paving program to cost $28,000,000, has been agreed on by the Indiana state highway commission for 1923, 1924 and 1925, Charles L. Zeigler, commission chairman, has announced. The announcement was made after several days of conferences with Governor McCray and John D. Williams, director of the state highway department. In addition to the paving program the commission will improve about 300 miles of roads.

Cement Prices and Shipments

Portland cement declined in price (exclusive of the cost of bags) from $1.89 a barrel in 1921 to $1.76 a barrel in 1922, according to the latest figures compiled by the United States Geological Survey, but not heretofore made public. Shipments for January and February this year indicate that the consumption of cement in 1923 will be even greater than last year. In these two months shipments totalled 11,382,000 bbl. as against a total of 6,216,000 bbl. in January and February, 1922, and 5,870,000 bbl. in 1921.

To take care of the increased demand for cement which is looked for in 1923, present plans call for seven new mills of substantial capacity to be in operation this year, which, with a number of smaller units, should increase the country's capacity to 150,000,000 bbl. It is estimated that actual production will be 20,000,000 to 25,000,000 bbl. over that of 1922.

There should be no shortage of Portland cement this year, according to the industry's spokesmen, providing purchasers do not concentrate their orders in the peak months of July, August, September and October.

Weekly Construction Market

THIS limited price list is published weekly for the purpose of giving current prices on the principal construction materials, and of noting important price changes on the less important materials. Moreover, only the chief cities are quoted.

Valuable suggestions on costs of work can be had by noting actual biddings as reported in our Construction News section.

The first issue of each month carries complete quotations for all construction materials and for the important cities. The last complete list will be found in the issue of April 5; the next, on May 3.

Steel Products:	New York	Atlanta	Dallas	Chicago	Minneapolis	Denver	San Francisco	Seattle	Montreal
Structural shapes, 100 lb.	$3.44	+$4.30	$4.50	$3.30	$3.55	$4.20	$3.85	$4.10	$3.75
Structural rivets, 100 lb.	4.00	+5.00	5.25	3.75	4.25	5.15	+5.00	4.50	6.00
Reinforcing bars, ¾ in. up, 100 lb.	3.34	+4.25	3.15	3.22½	3.45	3.85	3.40	4.10	3.50
Steel pipe, black, 2½ to 6 in. lap, discount	+49%[1]	+50%	45%	59½%	+53-5%	+36%	38.2@50.2%	45%	32.76
Cast-iron pipe, 6 in. and over, ton.	58.50	58.00	57.00	58.20	60.50	67.00	60.00	60.00	60.00
Concreting Material:									
Cement without bags, bbl.	2.80	3.25	2.25	2.20	2.39	2.85	2.71	2.90	2.68
Gravel, ¾ in., cu.yd.	2.25	1.90	2.25	2.25	1.75	1.90	2.15	1.25	1.50
Sand, cu.yd.	1.00	1.24	1.90	2.25	1.00	1.00	1.50	1.25	1.25
Crushed stone, ¾ in., cu.yd.	1.75	2.00	2.50	2.25	2.25	3.50	2.15	3.00	1.90
Miscellaneous:									
Pine, 3x12 to 12x12, 20 ft. and under, M.ft.	65.00	40.00	53.00	60.00	45.75	42.75	+41.00	31.00	95.00
Lime, finishing, hydrated, ton.	16.80@17.10	23.00	22.50	20.00	25.50	24.00	22.00	24.00	21.00
Lime common, lump, per bbl.	3.00@3.25	1.40	2.50	1.50	1.25	2.70	1.75	2.80	11.00
Common brick, delivered, 1,000	23.50	13.00	13.10	11.00	17@19	12.00	15.00	13.00	16.50
Hollow building tile, 4x12x12, per block	Not used	.0893	.115	....	.0836	.065	....	.11	.115
Hollow partition tile 4x12x12, per block	.1314	.0893	.115	.0674	....	.065	.108	.11	....
Linseed oil, raw, 5 bbl. lots, gal.	1.16	1.28	+1.42	1.25	1.34	1.41	—1.24	.86	—1.15
Common Labor:									
Common labor, union, hour.	.75	.35	.....	.....	.....	.50@.55	.56¼	....	.....
Common labor, non-union, hour.	.....	.30	.30@.50	.72½	.35@.50	.35@.50	.50	.30@.70	.25

Explanation of Prices—Prices are to contractors in carload lots unless other quantities are specified. Increases or decreases from previous quotations are indicated by + or — signs. For steel pipe, the prevailing discount from list price is given: 45-5% means a discount of 45 and 5 per cent. Charge is 15c. per 100 lb. for cutting reinforced steel into 2-ft. lengths or over.

New York quotations delivered, except sand, gravel and crushed stone, alongside dock; common lump lime, in 280-lb. bbl. net, and hydrated lime f.o.b. cars; tile "on trucks"; linseed oil and cast-iron pipe f.o.b.

Labor—Concrete laborers' rate, 81½c.; building laborers, 75c.; minimum for pick and shovel men, 50c. per hr.

Chicago quotes hydrated lime in 50-lb. bags; common lump lime per 180-lb. net. Lumber delivered on job.

Minneapolis quotes on fir instead of pine. Brick, sand and hollow tile delivered. Cement on cars. Gravel and crushed stone quoted at pit. We quote on brown lime per 180-lb. net; white is $1.70 for Kelly Island and $1.60 for Sheboygan. Common labor not organized.

Denver quotes on fir instead of pine. Cement "on tracks"; gravel and sand at pit; stone on cars; lime, brick, hollow tile and lumber on job. Tile price is at warehouse. Linseed oil, delivered, in iron bbl. Common lump lime per 180-lb. net.

Atlanta quotes sand, stone and gravel per ton instead of cu.yd. Common lump lime per 180-lb. net.

Dallas quotes lime per 180-lb. bbl. Steel, cement, cast-iron pipe and crushed stone f.o.b. cars, other materials delivered.

San Francisco quotes on Heath tile, 5½ x 8 x 11½. Prices are all f.o.b. warehouses except C. I. pipe, which is mill price plus freight to railway depot at any terminal. Common lump lime per 180-lb. net. Lumber prices are to dealers in yards at San Francisco, for No. 1 fir common.

Seattle quotes on Douglas fir (delivered) instead of pine. Lump finishing lime per 180-lb. net. Hollow building tile delivered. Hydrated lime in paper sacks. Sand and gravel at bunkers.

Montreal quotes on pine casing. Sand, stone, gravel and lump lime per ton. Cement, lime and tile are delivered; sand, gravel and stone on siding; brick f.o.b. plant; steel and pipe at warehouse. Hollow tile per ft. Cement price is in Canadian funds (the Canadian dollar stands at 98.20). Bag charge is 80c. per bbl. Discount of 10c. per bbl. for payment within 20 days from date of shipment. Steel pipe per 100 ft. net; 2½-in., $32.76; 6-in., $108.

Changes Since Last Week

Wrought-steel pipe discounts down two-points on new Pittsburgh basing card of April 19. Rise reflected in similar reduction in warehouse discounts at New York, Atlanta, Minneapolis and Denver.

Present price of steel plates not under $2.75 per 100 lb., Pittsburgh, for spot deliveries in the open market. As high as $2.90, however, named on some shipments. Quotations of $2.45 still hold for railway car orders in substantial tonnages. Considerable inquiry for steel plates at mills, mostly from car builders. Structurals, $2.50@$2.65; increasingly difficult to place orders at $2.45. Steel bars, $2.35@$2.75. Atlanta reports advance of 10c. on steel shapes and 15c. on rivets and bars; San Francisco quotes rise of 25c. per 100 lb. on rivets, during week.

Concreting materials, brick, lime and hollow tile showing uniform firmness in the nine cities reporting weekly to *Engineering News-Record*.

Douglas fir timbers, base sizes, quoted at $41 in San Francisco, against $39 per M. ft. b.m., last week. Telegraphic reports to the Lumbermens' Bureau from New York, state that while the "yellow pine demand is a bit slacker, prices might be expected to drop off, but short stocks and chaotic deliveries have offset any declines."

The National Lumber Trade Barometer, April 20, shows actual production nearly 5 per cent above normal, with shipments about 109 per cent and orders 100 per cent of normal production.

Linseed oil dropped 1c. in Montreal and 10c. per gal. in San Francisco, but advanced 7c. in Dallas.